FINAL REPORT FOR

CANADA MORTGAGE AND HOUSING CORPORATION

INVESTIGATION OF THE INDOOR AIR QUALITY, AIRTIGHTNESS, AND AIR INFILTRATION RATES OF A STATISTICALLY RANDOM SAMPLE OF 78 HOUSES IN WINNIPEG

File: 7224,DD#67

PREPARED BY:

G. K. YUILL AND ASSOCIATES LTD.
1441 Pembina Highway
Winnipeg, Manitoba
R3T 2C4

DECEMBER 14, 1987

88-06447/

TABLE OF CONTENTS

	SUMMARY	i
1.0	INTRODUCTION	1
2.0	SAMPLING TECHNIQUE AND LEVEL OF RESPONSE	2
2.1	House Selection	2
2.2	Success Rate	4
3.0	TEST METHODOLOGY	14
3.1	General Procedure	14
3.2	House Characteristics	14
3.3	Pollutant Measurements	16
3.3.1	Carbon Dioxide	16
3.3.2	Carbon Monoxide	17
3.3.3	Radon	17
3.3.4	Formaldehyde	18
3.3.5	Respirable Suspended Particulates	18
3.3.6	Ozone	19
3.3.7	Relative Humidity	19
3.4	Other Measurements	19
3.4.1	Sound Level Measurement	19
3.4.2	Airtightness	20
3.4.3	Infiltration Rate	20
4.0	RESULTS OBTAINED	21
4.1	Introduction	21
4.2	The Data Sets	21
4.2.1	The Homeowner Survey Report	21
4.2.2	The Technical Report	22
4.2.3	The Indoor Air Quality Report	22
4.2.4	Fan Noise Report	22
4.2.5	Measurement Sites	22
4.2.6	HOT-2000 Data Input	22
4.2.7	The Airtightness Test Report	23
4.2.8	The Infiltration Test Report	23

4.3 Data Summaries 23

4.4 Discussion of the Data 28

5.0 ANALYSIS OF THE DATA 29

6.0 CONCLUSIONS 30

APPENDIX A - PRELIMINARY LETTER TO HOUSEHOLDER

APPENDIX B - COMPLETED SET OF SURVEY FORMS

APPENDIX C - DETAILED TRACER GAS TESTING PROCEDURES

APPENDIX D - BOSS DATA FILE PRINTOUT

APPENDIX E - FAN LOCATIONS - HOMEOWNER SURVEY

SUMMARY

An investigation of the indoor air quality, air tightness and air infiltration rates of a random sample of 78 houses in Winnipeg was conducted in the summer and fall of 1987. The sample consisted entirely of single detached dwellings. In addition to the air quality and air tightness measurements taken, the physical characteristics of each house were recorded, along with information on occupant behavior and attitude towards indoor air quality.

The objective of this project was to obtain results that were representative of the Winnipeg housing stock. Therefore, a three-level sampling procedure was adopted and every effort was made to obtain positive responses from homeowners of the houses selected by this procedure. Rate of homeowner acceptance to participate in the survey varied from one census district to another. However, each census district had similar types of housing throughout and the lower acceptance rates in some of these districts should not affect the validity of the study.

Indoor air quality was determined by measuring the pollutant levels at three locations in the home. The pollutants measured were carbon dioxide, carbon monoxide, formaldehyde, radon, ozone and respirable suspended particulates.

Air tightness was measured by the fan depressurization method. Intentional openings which include chimneys, flues, intake and exhaust ports, floor drains and sumps were left open.

Air exchange rate was measured using the tracer gas technique. Initial concentrations of approximately 50 parts per billion sulphur hexafluoride were established and the rate of decay was then measured over a period of one hour. This rate of decay was then used to calculate the rate of air infiltration.

Indoor air quality was related to the usage of exhaust fans in the home. Each fan was described in detail and its frequency of use was recorded. The noise level of each fan was measured with a sound level meter. Noise levels at nine preferred frequencies were also measured.

A homeowner survey report was used to record personal data about the occupants. It also recorded their attitudes towards indoor air quality and any indoor air quality problems in the home. Other forms were used to describe some of the physical characteristics of the home in detail. Some of these characteristics include terrain and shielding information and information about the heating, ventilating and air conditioning systems.

A large amount of data was collected in the present project. Parts of the data have been included in two data summaries. The first summary contains data on pollutant levels, air tightness, air infiltration rate, census district, house age and number of occupants. The second summary includes all information collected in the Homeowner Survey. These summaries are available on BOSS and LOTUS 123 data files. Thus, many interesting correlations can be made with little effort.

1.0 INTRODUCTION

In recent years it has been realized that our greatest exposure to pollution is not outdoors but in our homes and workplaces, where we spend the majority of our time. However, the magnitude of the problem has not yet been clearly defined. We do not know the heatlh effects of most pollutants with certainty, or do we know their concentration distributions. The purpose of this project was to learn more about the latter.

Among the factors which influence pollutant concentration in a house are its location, its age, its physical characteristics. To study the influence of all these parameters will require that a large variety of houses be studied. Using a large enough random sample of housing should provide this variety and also provide results that are representative of the housing stock in the region sampled. Of course, in obtaining a sample of this nature, self selection should be avoided since homeowners who are concerned about their indoor air quality or have noticeable indoor air quality problems would be the first to participate.

While the physical characteristics of the home may affect the indoor air quality, occupant behavior is also an important factor. For example, ventilation fans can help to maintain indoor air quality but are frequently not used because homeowners object to the noise. Other examples of practices which may affect indoor air quality are the frequency with which windows are opened and closed and hobbies such as wine making, painting and ceramics. Information about these practices should be recorded in a detailed study.

This report summarizes the results from an indoor air quality study of 78 randomly selected houses in Winnipeg. Indoor air quality which is determined by measuring the various pollutant levels is related to air tightness, air exchange rate and occupant behavior. Noise levels of exhaust fans are measured and related to their frequency of use.

2.0 SAMPLING TECHNIQUE AND LEVEL OF RESPONSE

2.1 House Selection

The objective of the house selection procedure was to ensure that the houses studied were representative of the Winnipeg housing stock. A three-level sampling procedure was used. First, 13 census tracts were selected at random from the 127 census tracts in the City of Winnipeg. Then a list of all the streets in each census tract was made, and three streets were selected at random. From each street, two houses were then selected at random.

To eliminate bias from a sample of households, it is necessary to eliminate self selection. Obviously, a sample obtained by response to an advertisement could be biased. The selection technique used in the present study would eliminate self selection if all the householders selected by the random sampling technique agreed to participate. Every effort was made to come as close as possible to that objective.

It was decided that little bias would be introduced into the study by excluding those who were not at home when called upon, provided that all calls were made in the early evening. This time was chosen so that there would be no bias towards families in which an adult member was at home during the day. When a call was made on a selected house and no one was home, it was replaced with the house next door.

Every effort was made to ensure that the householders who were at home when called upon would agree to participate in the study. This was done by:

1. Arranging media publicity about the study. This media coverage emphasized that although some householders suspected that the study was a front for a selling effort, this was not the case.

2. Arranging for the local Conservation and Renewable Energy Office of Energy Mines and Resources Canada to act as a reference for the legitimacy of the project.

3. Preparing a preliminary letter (see Appendix A) which was sent out to each householder shortly before he was called on. This letter was accompanied by a newspaper clipping about the project.

4. Choosing personable and aggressive people to make the calls on the householders, and having them trained in door-to-door selling techniques.

This approach resulted in a good overall acceptance rate, but it was not successful in some of the census tracts. Close to one-hundred percent acceptance was frequently achieved in the higher-income census tracts, while on one street in a low-income area, the acceptance rate fell to about 4%. About one third of these householders would not even answer their doors, and the majority of the rest simply slammed the door as soon as they realized the caller was not someone known to them. Thus there was no possibility of achieving a high acceptance rate on this street or on some others where attitudes were similar.

This poor acceptance rate in some census tracts may have biased the sample. However, the houses finally selected in these areas were always similar in age and appearance to the ones originally selected at random.

It is difficult to assess the possibility of correlations between householder attitude towards canvassers and the variables measured in this study. However, there is no reason to expect any strong correlation in the houses on a given street. Therefore, no attempt has been made to correct the results obtained for any bias due to the high rejection rates in some districts.

Table 2.1 shows the average house age for the entire sample and for the sub sample for each census district. These are compared with

the Statistics Canada data on house age for the same areas. Table 2.2 shows the same comparisons for number of rooms and Table 2.3 for number of occupants. These tables indicate how typical the houses selected in this study were of the population as a whole.

Due to an error in record keeping, two houses were surveyed which were in the wrong census tracts. Thus two census tracts have five houses in them, and two have seven. Since this error was completely random, it should have no significant impact on the results of the study.

Figure 2.1 shows the distribution of the census tracts selected in the City of Winnipeg.

2.2 Rate of Success in Gaining Access to the House Originally Selected

The success rate for access varied substantially between census districts. In general, high success rates were achieved in high-income areas; low success rates were achieved in low-income areas.

Throughout the survey, several approaches were attempted to obtain access to the houses originally selected in the sample of 78 houses. The most important aspect in obtaining cooperation in the survey was to give each homeowner a clear understanding of what the survey was about. Thus, when communicating with each homeowner, the recruiter had to first inform the homeowner on all important details and, then, obtain homeowner acceptance to participate in the survey. In general, a positive response was usually obtained if the homeowner took the time to become informed on the details of the survey. Once informed, homeowners who participated did so because they were interested in the survey or felt that it was their duty so as to not affect the statistical validity of the survey.

TABLE 2.1

Average Age of Homes Surveyed in Each Census District

Census District	Average Age of Home Surveyed	Average Construction Period Based on Statistics Canada Data
1	1934	1921 - 1945
2	1923	1921 - 1945
3	1960	1946 - 1960
4	1952	1946 - 1960
5	1924	1921 - 1945
6	1946	1921 - 1945
7	1942	1921 - 1945
8	1946	1946 - 1960
9	1939	1921 - 1945
10	1938	1921 - 1945
11	1948	1946 - 1960
12	1966	1961 - 1970
13	1964	1961 - 1970

Average Age of Homes Surveyed: 1945

Statistics Canada Census Tract Numbers:

1 - 009.00
2 - 018.00
3 - 502.00
4 - 050.02
5 - 046.00
6 - 113.00
7 - 027.00
8 - 123.00
9 - 007.00
10 - 531.00
11 - 050.01
12 - 510.00
13 - 101.02

TABLE 2.2

Average Number of Rooms in Homes Surveyed in Each Census District

Census District	Average Number of Rooms in Homes Surveyed	Average Number of Rooms Based on Statistics Canada Data
1	7.3	6.9
2	7.5	6.7
3	5.3	6.0
4	5.8	5.4
5	6.3	5.9
6	5.0	5.2
7	8.2	6.3
8	7.5	5.9
9	6.3	6.2
10	6.2	5.2
11	5.5	5.2
12	10.0	9.0
13	9.4	6.4
Mean	6.9	6.2

Statistics Canada Census Tract Numbers:

1 - 009.00
2 - 018.00
3 - 502.00
4 - 050.02
5 - 046.00
6 - 113.00
7 - 027.00
8 - 123.00
9 - 007.00
10 - 531.00
11 - 050.01
12 - 510.00
13 - 101.02

TABLE 2.3

Census District	Average Number of Occupants in Homes Surveyed	Average Number of Occupants Based on Statistics Canada Data
1	4.3	2.8
2	3.2	2.7
3	3.6	3.0
4	3.3	2.7
5	4.0	3.0
6	2.5	2.6
7	2.7	2.5
8	2.8	3.0
9	2.8	2.5
10	1.8	2.6
11	2.2	3.1
12	3.4	3.6
13	2.5	3.2
Sample Total Mean:	3.0	2.9

Statistics Canada Census Tract Numbers:

1 - 009.00
2 - 018.00
3 - 502.00
4 - 050.02
5 - 046.00
6 - 113.00
7 - 027.00
8 - 123.00
9 - 007.00
10 - 531.00
11 - 050.01
12 - 510.00
13 - 101.02

Winnipeg Census Tracts 1981

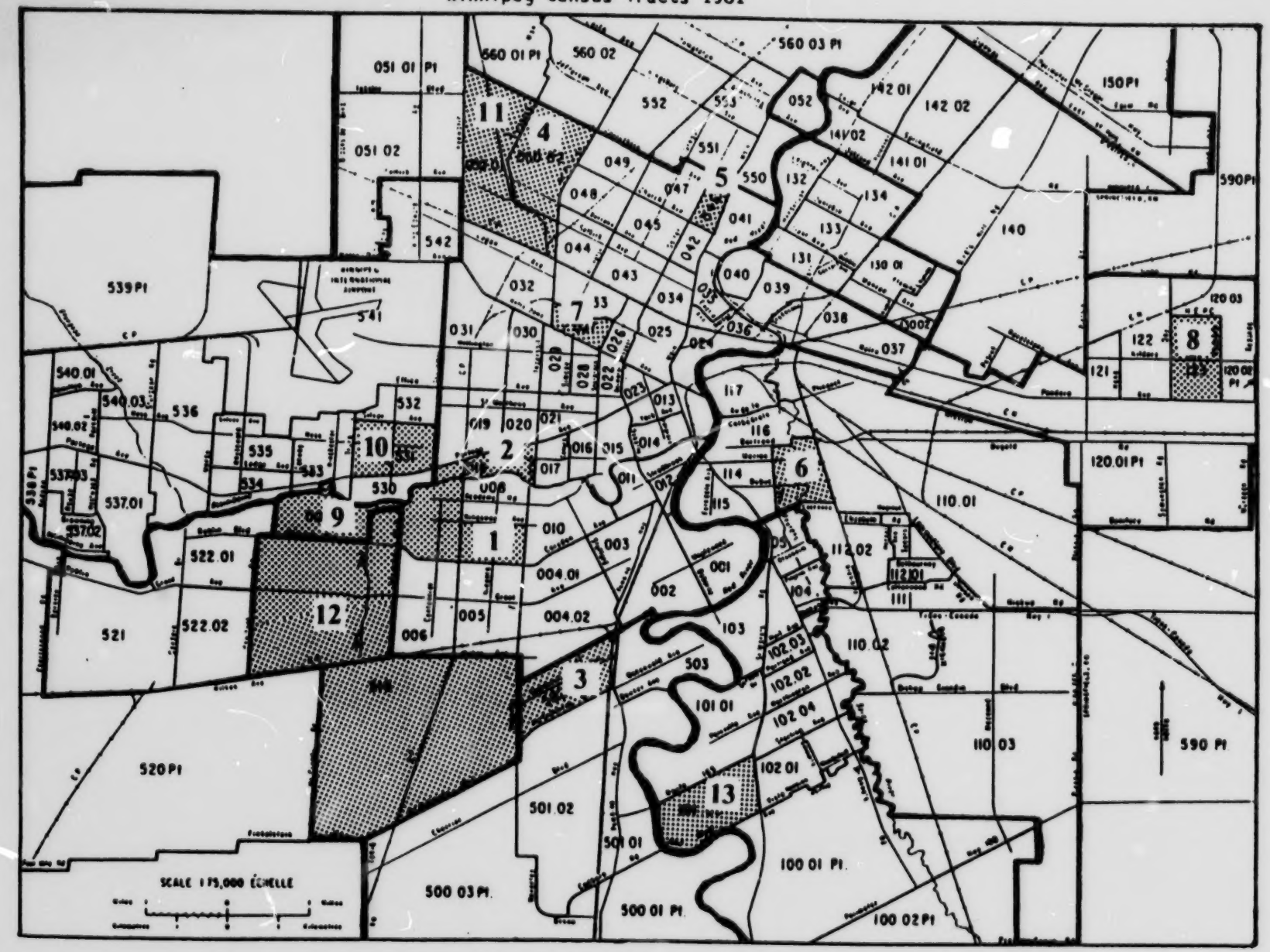


Figure 2.1

Upon commencement of the survey, preliminary letters were sent out to 78 randomly selected houses. Once each homeowner had sufficient time to receive and review the letter, a personal visit was made to most of these houses. The remainder were contacted by telephone. At this time, the letter did not contain any references from government organizations and the positive response level was relatively low. It is important to note that the names and addresses were obtained from the Henderson Directory and approximately 10 percent of the letters were returned because some of the occupants were no longer at those addresses.

Level of homeowner acceptance to participate in the survey increased when the survey gained media publicity and after permission was obtained from Energy Mines and Resources to use them as a reference in the preliminary letter. Newspaper clippings which covered the survey were attached to the revised letter. These letters were delivered personally and after the homeowner was introduced to the survey in person, the homeowner either accepted to take part or was left with the letter to review before making a decision. Where letters were left in the mail box, the homeowner was contacted by telephone within a few days.

Personalized letters were delivered to most homeowners. In areas where the acceptance rate was low, a canvasser had to go door to door along the block containing the selected house to obtain the required number of participants for that area. In some cases, this involved personal visits to many houses.

The homeowner acceptance rate may have been affected by the time of year that houses were recruited. Homeowners were contacted from July through October. Because there were some changes in the recruiting strategy throughout the survey, it is difficult to assess how the acceptance rate changed over this time period.

Figure 2.2 shows the fraction of houses where occupants were home when called upon. Figure 2.3 shows the fraction of houses which were either the original house selected, or the first house where occupants

were home starting from the originally selected house, to which access was gained. Figure 2.4 shows the overall success rate for each district. The response level is the number of houses tested divided by the number of houses contacted. Houses where occupants were not at home were not considered as negative responses.

Response levels in the 13 randomly selected census districts range from 15 percent to 88 percent. When expressed in terms of response level per street, the values range from 4 percent to 100 percent.

Figure 2.2 Percentage of Calls Where Occupants were Home

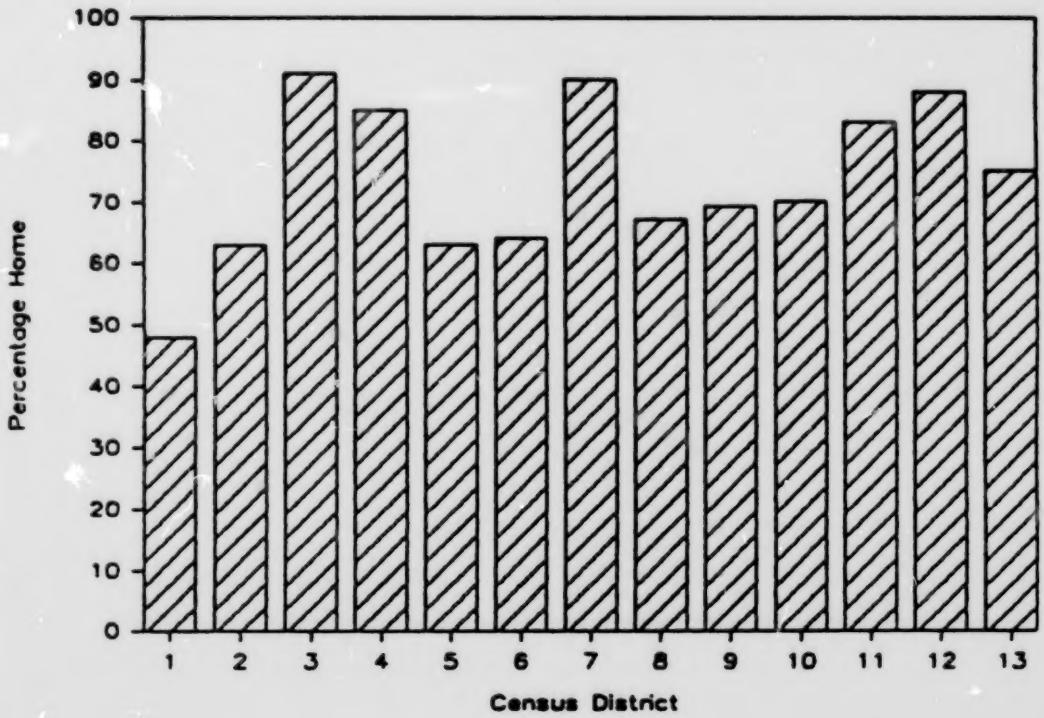


Figure 2.3. Percentage of Houses Which were Either:

1. the house originally selected or,
2. the first house that occupants were home starting from the originally selected house;

to which access was gained.

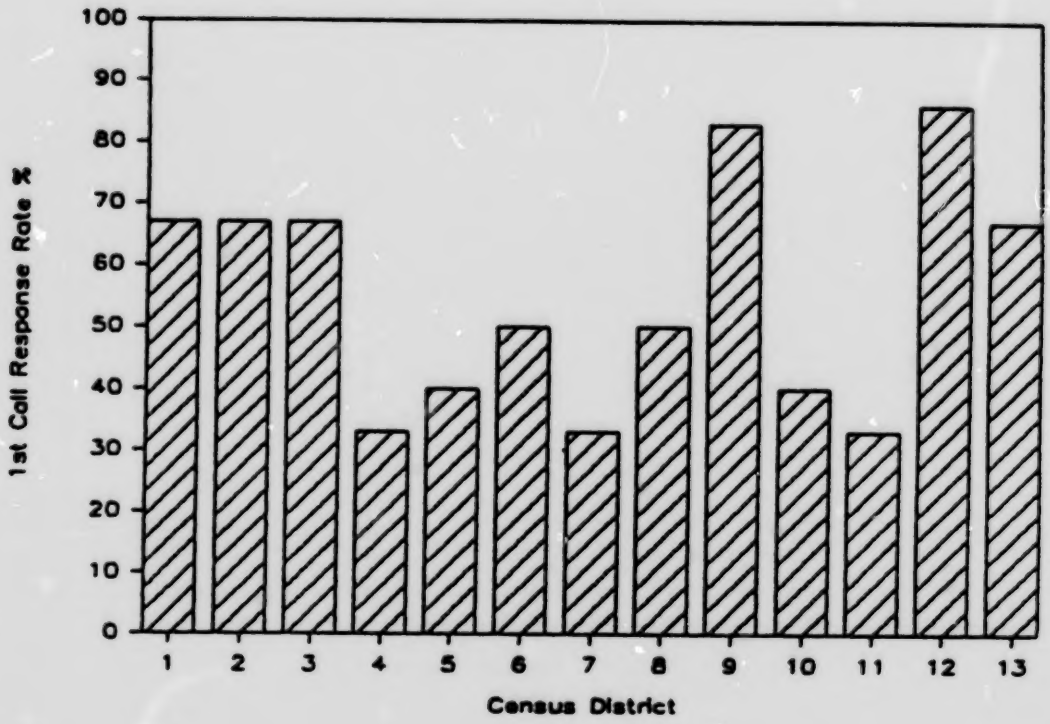
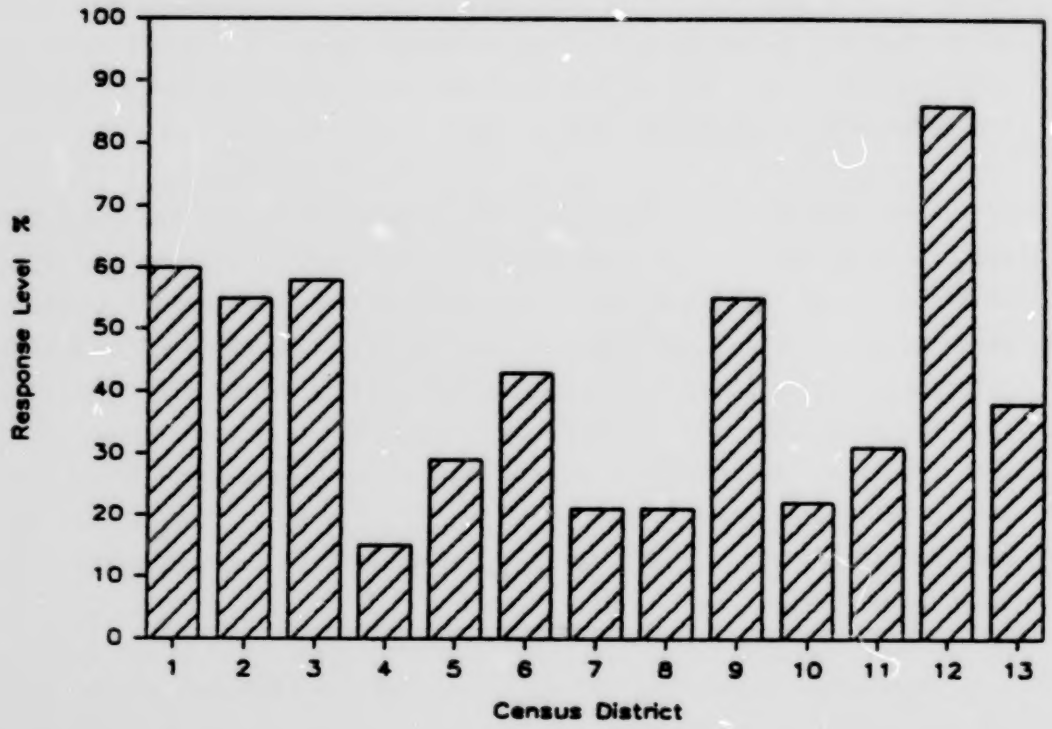


Figure 2.4. Average Number of Houses Called Upon per House to Which Access was Gained



3.0 TEST METHODOLOGY

3.1 General Procedure

Houses were tested for indoor air quality, air infiltration rates, air tightness and noise level of exhaust fans. Each house was tested by a survey team consisting of two team members. The total time for testing was approximately 3 1/2 hours and involved two visits to the house. This amount of time was tolerated by most homeowners and was sufficient for gathering all of the relevant data. Additional time was required for travelling to and from the test locations and to analyze the radon and formaldehyde samplers back at the office.

The first visit involved the homeowner interview, pollutant measurements, and the measurement of air infiltration rate using sulphur hexafluoride as the tracer gas. Included in the pollutant measurements were carbon dioxide, carbon monoxide, radon, formaldehyde, respirable suspended particulates, and ozone. Other tasks performed in this visit included filling in the HOT-2000 Data Input Sheet and recording all of the technical information on the space heating, ventilating, air conditioning and domestic hot water heating systems. Exhaust fan data was recorded as well. This first visit would take approximately 2 1/2 hours to complete.

The second visit involved measuring the air tightness of the house and measuring the noise level of each exhaust fan in the house. Noise level measurements were usually made by one survey team member while the other was setting up the blower door for the air tightness test. Measurements and calculations for the air tightness tests were conducted according to the Canadian General Standards Board (CGSB) "Standard for Determining the Airtightness of Building Envelopes by the Fan Depressurization Method" (CAN/CGSB-149.10-M86). However, contrary to the standard, all intentional openings were left open. Where possible, this second visit was scheduled one week after the first visit. At this time, the radon canister which sampled the air for seven days was picked up. Depending on the number of exhaust fans in the house, this visit would take approximately 45 minutes to 1 hour.

In some cases, it was necessary to conduct more than two visits. This was due to the following:

1. After sampling the radon levels in the home for seven days, radon canisters were usually picked up when blower door tests were performed. When high winds prohibited a blower door test, the canister was picked up and the blower door test was scheduled for a later date.

2. The radon canisters were required to arrive in Pittsburgh for analysis no later than 12 days after they were exposed. In a few cases they arrived there later due to delays in the mail, and the results from their analyses were inconclusive. Subsequent visits were required to expose a new canister.

3. The sound level meter was on loan from the University of Manitoba. On a few occasions, this instrument could not be obtained. Thus, additional visits were required to complete the noise level survey.

Sections 3.3 and 3.4 give more detailed descriptions of the measurement instrumentation and techniques used in these tests.

3.2 House Characteristics

A homeowner survey, technical survey and HOT-2000 data input sheet were completed for each house. This information was required to physically describe the house and to determine other information such as homeowner attitude towards indoor air quality, number of occupants, time that each occupant spends in the home, and practices within or outside the home which may affect the indoor air quality.

The homeowner survey covered a wide variety of information. Most of the questions were related to occupant behavior and attitude. Physical characteristics of the house which may or may not affect energy consumption and indoor air quality were answered as well.

The technical survey recorded in detail the descriptions of space heating systems, air conditioning systems, domestic hot water systems and ventilating systems. A visual assessment which described the terrain and shielding class of each house was also made.

The physical characteristics of the home were recorded in the HOT-2000 data input form. This form was completed in full so that it could be run through the HOT-2000 program.

A homeowner survey, technical survey, and HOT-2000 data input sheet, along with all of the data recorded from monitoring were filed for each house. As an example, one complete set of forms for one survey house are included in Appendix B.

3.3 Pollutant Measurements

3.3.1 Carbon Dioxide

The carbon dioxide concentration was measured at three locations in each house with a Horiba Model APBA-210 Portable CO_2 Monitor. The principle of measurement was that of a non-dispersive infrared analysis. Its two ranges of measurement were from 0 to 2000 ppm and 0 to 5000 ppm.

Prior to the arrival at the test location, the CO_2 monitoring device was turned on. A warm-up period of at least 15 minutes was required for accurate measurements. Arriving at the site with the instrument ready to monitor the carbon dioxide concentrations allowed the survey team to measure the concentrations before their presence had any effect on the results.

The instrument was calibrated before each test. Two calibration gases were transported to the site to perform the calibration. The low end calibration gas was CO_2-free air while the upper end gas contained a carbon dioxide concentration of 1018 ppm.

3.3.2 Carbon Monoxide

The carbon monoxide concentrations were measured with a MONOGARD CO instrument. This device had a LCD digital display and provided continuous measurement of carbon monoxide levels from 0 - 999 ppm. Carbon monoxide was sensed by a galvanic chemical cell which changed its electrical output with changes in carbon monoxide concentrations.

The instrument required little warm-up time. However, a 30-second stabilization time of sensing and read-out circuits was necessary.

Calibration of the CO monitoring device was similar to that of the CO_2 monitor. Calibration gases of CO-free air and 14.5 ppm carbon monoxide air were used. The manufacturer recommended that the instrument be calibrated once a month. In conducting our tests, this device was calibrated daily.

3.3.3 Radon

Radon levels in the surveyed houses were measured by two methods. Instantaneous measurements of Working Level (WL) were made at three locations in the house using membrane filtration. Radon was also measured by placing a week-long passive sampler in the basement.

The membrane filtration technique involved the drawing of 30 liters of air through a Nucleopore .8 *m membrane filter. A Gilian Hi Flow Sampler operating at 3 liters per minute for 10 minutes was used to perform this task. The filter was analyzed with a Pylon Instruments RM-1003 Radon Detector. This instrument was calibrated with an Am241 Alpha Test Source with known activity of 19691 dpm. Once a week, this source was used to verify the efficiency of the scintillation counter. Measured count rates from each filter, counting efficiency, sample volume, and the time between testing and analysis were used in the calculation of radon levels.

Week-long radon measurements were made with a passive sampling canister developed by The Radon Project at the University of Pittsburgh. A canister was placed in the basement on the first visit to the house. When conducting the blower door test on the second visit, the canister was picked up, sealed, and sent to Pittsburgh for analysis.

3.3.4 Formaldehyde

An STC Formaldehyde Monitoring Kit developed by Air Technology Labs Inc. was used for measuring the formaldehyde levels at three locations in the home. The color method used in this kit was the 3-methyl-2-benzothiazolone hydrazone hydrochloride (MBTH) method recommended by the America Public Health Association.

A sample of formaldehyde was collected with a Passive Bubbler sampler contained in the kit. At the time of testing, 5 mls of distilled water and a tablet of Formaldehyde Reagent A were added to the bubbler. The bubbler was then capped with a fresh diffusion disk and a holed cap. The start time was recorded and the Bubbler was placed in the sampling location for approximately 2 hours. The sampling was complete when the holed cap and disk were removed and replaced with a solid cap.

The analysis was conducted 1 hour after the completion of the test. One ml of Formaldehyde Reagent B was added to the bubbler and after a waiting period of 15 minutes, the developed color was read off of the colorimeter. Before each analysis, the colorimeter was zeroed against clear water. Formaldehyde levels in terms of parts per million were then calculated knowing the developed color (percent transmittance) and the sampling time.

3.3.5 Respirable Suspended Particulates

Respirable suspended particulates were measured at three locations in the home with a Respirable Dust Monitor, Model No. RDM-101, developed

by GCA/Technology Division. This monitoring device had a direct digital read-out in milligrams per cubic meter.

3.3.6 Ozone

A Drager Multi Gas Detector Pump with long range ozone detector tubes was used to measure the concentration at one location in the house. To perform the measurement, 100 strokes of the Bellows pump were required. Although the accuracy of this technique was limited, it was able to give a good indication of the levels which were above ambient conditions. Cases where the concentration was above 5 ppb were in houses with electrostatic air cleaners.

3.3.7 Relative Humidity

Relative humidity was measured with a sling psychrometer. Readings of wet-bulb and dry-bulb temperatures were taken on each floor of the building. These temperatures were converted to a relative humidity using the Relative Humidity Tables published by Taylor Instrument Companies of Canada Limited.

3.4 Other Measurements

3.4.1 Sound Level Measurement

The noise level of each exhaust fan was measured with a Bruel & Kjoer sound level meter. Signals were processed by two different methods:

1. A Weighting Network which corresponds to an inverted equal loudness contour at low-pressure levels,
2. A Linear Network which enables the signal to pass through unmodified.

In addition to these measurements, a frequency analysis which measures the sound levels at nine preferred frequencies was also performed.

The sound level meter was calibrated before and after each test. For each fan that was tested, measurements were made on the background noise and the total noise which was the background noise and total noise combined. All measurements were made in the room where the fan was located.

3.4.2 Airtightness

Airtightness was measured by the fan depressurization method. A blower door with an axial fan, bell-mouthed nozzle and manometers for measuring the flow rate of air leaving the house and the indoor/outdoor pressure differential, was employed to determine airtightness. Testing was conducted according to the CGSB Standard, "Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method" (CAN/CGSB-149.10-M86) with exception to its requirements for preparation of intentional openings. No sealing measures were taken. However, dampers on fireplaces were closed since they are normally closed when fireplaces are not utilized. While this practice increased the measured equivalent leakage area, it was consistent with the procedures carried out during the tracer gas tests.

3.4.3 Infiltration Rate

Infiltration rate or air exchange rate was measured using the tracer gas technique. A small amount of sulphur hexafluoride was released inside each house and was allowed to mix with the room air for approximately 1/2 hour. Its rate of decay was then measured and related to tne rate of air infiltration.

A detailed set of procedures which were closely followed when conducting the tracer gas tests in this survey are contained in Appendix C.

4.0 RESULTS OBTAINED

4.1 Introduction

Seventy-eight Winnipeg houses were surveyed in this study during the period July to October, 1987. For each, 8 sets of data were gathered. These were:

1. the homeowner survey report,
2. the technical survey report,
3. the indoor air quality report,
4. the fan noise report,
5. the measurement sites map,
6. the HOT-2000 data input form,
7. the fan depressurization test report, and
8. the tracer gas infiltration test report.

A completed example of each of these test reports is attached as Appendix B. The total data set includes over 60 pages of data forms and over 750 primary observations or measurements (depending on the equipment in the house).

No data on the actual energy consumption of the houses studied was collected. However, each householder signed two consent forms permitting the local gas and electricity utilities to release their billing information.

4.2 The Data Sets

4.2.1 The Homeowner Survey Report

In the homeowner survey, 166 data items were collected. These included house identification, personal data about the occupants, energy conservation features of the house, several indoor air quality questions, questions about moisture problems, questions about heating, ventilating, and air conditioning equipment, and questions about fan use.

4.2.2 The Technical Report

The technical report contains 71 further data items. These included the terrain and shielding information necessary to predict infiltration, and more detailed information about the heating, ventilating and air conditioning equipment.

4.2.3 The Indoor Air Quality Report

The indoor air quality report contains 75 items of data. These included measurements of radon, formaldehyde, carbon monoxide, carbon dioxide, temperature, relative humidity, ozone and respirable suspended particulates. Certain observations concerning radon and formaldehyde sources were also included. Finally, the weather conditions were recorded.

4.2.4 Fan Noise Report

The fan noise report contains up to 250 observations, depending on the number of fans. This included a detailed description of each fan, the acoustic properties of the room, and a measurement of the noise level in each of nine frequency ranges.

4.2.5 Measurement Sites

In this report, several pages of room maps are presented to show the locations of sound level and pollutant measurements. All of the measurements were made at a central location in each room and at a height of approximately 1.2 meters above the floor with the exception of the radon and formaldehyde measurements. Passive samplers for monitoring these pollutants were placed on furniture or shelving with sampling heights ranging from 0.5 to 1.5 meters. Thus, these samplers did not interfere with occupant activity.

4.2.6 HOT-2000 Data Input

This report contains all the information about the house necessary to carry out a HOT-2000 energy analysis.

4.2.7 The Airtightness Test Report

The airtightness test report follows the format of the report form presented in CGSB Standard CAN/CGSB-149.10-M86.

4.2.8 The Infiltration Test Report

In the infiltration test report, the results of the tracer gas decay test for infiltration rate are presented.

4.3 Data Summaries

It was not possible in the present project to analyze the large amount of data which has been collected. Two data summaries have been prepared which present parts of the data collected in forms convenient for future analysis. The first of these is presented in Table 4.1. This table contains data on pollutant levels, air tightness, fans, and house age. The data in this table is also available on a LOTUS 123 data file for more convenient correlation and graphing.

The second data summary includes all the information collected in the Homeowner Survey, in a BOSS data file. This data file was prepared to be compatible with the files which EMR maintains on R-2000 houses. Appendix D is a printout of the contents of the BOSS data file.

A project (not supported by a contract) is being carried out to analyze the relationship between fan noise, fan use, and indoor air quality, using the data gathered in this study. The results of that project will be forwarded to CMHC when it is completed.

TABLE 4.1

I.D.	LIVING ROOM					BASEMENT					BEDROOM				DURING	TRACER	BAG TEST		# of Exhaust Fans	AIR TIGHTNESS			AIR INFILT.
	CO2 (ppm)	CO (ppm)	ROP (mg/m3)	HCOH (ppm)	Rn(1) (WL)	CO2 (ppm)	CO (ppm)	HCOH (ppm)	Rn(1) (WL)	Rn(2) (pCi/L)	CO2 (ppm)	CO (ppm)	HCOH (ppm)	Rn(1) (WL)	CO2 (ppm)	CO (ppm)	ROP (mg/m3)	Ozone (ppb)	Rn(1) (WL)		ELA (cm2)	NLA (cm2/m2)	ACH (at 50Pa)	ACH
1	360	2			0.0004	500	4		0.0250	3.2	340	2		0.0020						3	1718	4.160	7.63	0.51
2	620	0			0.0103	540	0		0.0195	2.8	570	0		0.0145	600	0				0	1192	2.908	5.90	0.25
3	400	1		0.000	0.0054	450	0	0.000	0.0007	1.6	500	0	0.000	0.0070		0				3	1796	3.736	7.04	0.43
4		1					1		0.0025	3.5		1												
5	630	2			0.0019	500	2		0.0030	0.8	520	2		0.0031	710	2			0.0056	0				0.20
6	400	0			0.0062	450	1		0.0003	3.2	410	0		0.0061	550	0			0.0031	3	874	1.747	3.26	0.15
7	560	0				430	1		0.0020	10.8	370	0			550	0	0.0	0		1	1519	2.773	5.12	0.48
8	900	0	0.1		0.0061	900	0		0.0015	2.0		0		0.0090		0	0.1	0	0.0132	3	1650	3.152	6.11	0.42
9	550	0	0.0		0.0017	550	0		0.0023	1.6	600	0		0.0083						0	1560	5.053	8.10	0.20
10	480	0	0.0	0.111	0.0030	500	0	0.129	0.0010	1.8	500	0	0.103	0.0020	500	0	0.0	0	0.0020	1	1504	3.196	11.59	0.00
11	750	0	0.0	0.051	0.0020	500	0	0.000	0.0029	1.2	750	0	0.000	0.0010	860	0	0.0	0	0.0010	0	1391	4.225	8.60	0.25
12	700	4	0.0	0.053				0.076	0.0022	2.5					1200	1	0.0	0	0.0022	1	935	3.290	8.10	0.12
13	1000	4			0.0003	680	2		0.0056	4.5	900	2			1000	5				3	1010	2.937	7.23	0.25
14	560	0	0.0	0.067	0.0013	850	1	0.002	0.0402	1.8	900	0	0.067	0.0027	1000	1	0.1	0		1	1760	4.387	11.13	0.00
15	1750	0				970	0		0.0169	3.1					600	3			0.0020	1	609	1.630	3.97	0.09
16	520	0		0.003	0.0015	500	0	0.056	0.0010	1.7	470	0	0.009	0.0003	600	0			0.0036	1	1102	3.320	8.14	0.19
17	575	2				475	2		0.0060	4.0				0.0063	1550	2				2	475	1.126	2.66	0.07
18	800	1			0.0018	720	1		0.0043	1.1	900	0		0.0008	900	1			0.0049	2	542	1.284	2.71	0.10
19	700	1	0.0	0.094	0.0068						650	1	0.000	0.0046	750	1	0.0	0	0.0068	2	1425	4.581	15.09	0.60
20	850	0			0.0020					1.2	800	0		0.0041	1000	0				0	1375	5.163	15.95	0.66
21	710	0	0.1	0.000	0.0050	600	1	0.000	0.0065	1.6	710	0	0.000	0.0065	800	0	0.0	0	0.0065	1	1002	3.372	8.32	0.37
22	1100	0			0.0016	900	0		0.0153	5.0	1000	0								2	889	2.642	5.63	0.20
23	600	4			0.0002	1000	3		0.0007	1.4	675	2		0.0004						2	531	1.549	4.20	0.16
24	800	0	0.0	0.030	0.0010	600	1	0.020	0.0030	2.7	800	0	0.000	0.0000	810	0	0.0	0	0.0000	0	837	3.041	7.01	1.02
25	920	1	0.0	0.037	0.0023	800	1	0.003	0.0046	3.3	630	0	0.090	0.0015	1120	1	0.0	0	0.0033	1	1743	4.420	11.53	0.45
26	770	0	0.0	0.079	0.0007	650	0	0.009	0.0118		650	0	0.009	0.0057	900	0	0.0	0	0.0067	2	1619	4.059	12.24	0.17
27	1450	1	0.1	0.008	0.0354	1300	0	0.001	0.0411		1400	1	0.001	0.0130	1500	1	0.1	0	0.0330	1	511	1.581	4.06	0.12
28	450	1	0.0	0.000	0.0000	350	0	0.000	0.0000	7.2	450	0	0.000	0.0000	450	0	0.0	0	0.0000	1	2181	6.266	12.21	0.26
29	450	0	0.1		0.0020	400	0		0.0149	2.0	600	0		0.0025	700	0		0	0.0076	0	1227	3.975	8.05	0.27
30	760	0	0.0	0.032	0.0006	600	0	0.019	0.0101	5.4	850	0	0.010	0.0011	1050	0	0.0	0	0.0043	0	1136	2.948	6.59	0.27
31					0.0000				0.0011	1.7				0.0000				3		1	503	3.100	8.50	0.20
32	1050	1	0.1			1000	0		0.0103	9.3	900	1			1200	1	0.1	0	0.0257	1	1770	5.402	13.39	0.12
33	540	2	0.2	0.019	0.0014	490	1	0.000	0.0035	4.6	500	2	0.000	0.0010	1010	2	0.1	0	0.0148	2	1112	5.555	11.67	0.31
34	1300	0	0.0	0.000	0.0379	1300	1	0.000	0.0314		1350	0	0.000	0.0363	1350	0	0.0	0	0.0362	:	484	1.087	2.58	0.11
35	700	0			0.0004	690	0		0.0009	1.9	700	0		0.0000						0	993	3.632	6.17	0.54
36	750	0	0.0	0.108	0.0005	550	0	0.145	0.0018			0	0.006	0.0010	850	0	0.0		0.0006	1	574	1.401	3.23	0.20
37	550	0	0.1		0.0011	450	0		0.0079	2.1	340	0		0.0016			0.1	0	0.0016	1	564	1.697	3.28	0.28
38	900	0	0.0	0.154	0.0120	700	1	0.096	0.0310	2.0	900	1	0.134	0.0150	900	0	0.0	0	0.0120	3	761	1.801	3.87	0.11
39	560	0	0.1		0.0000	480	1		0.0011	3.3	480	0		0.0003	650	1	0.1	0	0.0006	2	602	2.348	7.09	0.15
40	670	0	0.0	0.137	0.0006	940	0	0.060	0.0011		620	0	0.145	0.0009	1000	0	0.1	0	0.0003	3	1291	3.350	7.72	
41	800	0	0.0	0.162	0.0000	800	0	0.132	0.0000	8.7	700	0	0.122	0.0000	1000	0	0.0	0	0.0000	0	559	1.799	4.72	0.29
42	950	1	0.0	0.005	0.0002	850	0	0.060	0.0039		1075	0	0.103	0.0040	1000	0	0.0	0	0.0000	1	1485	4.057	10.49	0.43
43	1300	1	0.2	0.151	0.0470	1150	0	0.141	0.0620	11.7	1300	0	0.162	0.0490	1410	1	0.0	0	0.0490	4	543	1.307	2.83	0.18

TABLE 4.1 (cont'd)

I.D.	LIVING ROOM					BASEMENT					BEDROOM				DURING TRACER GAS TEST					# of Exhaust Fans	AIR TIGHTNESS			AIR INFILT. ACH
	CO2 (ppm)	CO (ppm)	RSP (mg/m3)	HCHO (ppm)	Rn(i) (WL)	CO2 (ppm)	CO (ppm)	HCHO (ppm)	Rn(i) (WL)	Rn(a) (pCi/L)	CO2 (ppm)	CO (ppm)	HCHO (ppm)	Rn(i) (WL)	CO2 (ppm)	CO (ppm)	RSP (mg/m3)	Ozone (ppb)	Rn(i) (WL)		ELA (cm2)	NLA (cm2/m2)	ACH (at 50Pa)	
64	800	1	0.1	0.083	0.0020	1100	1	0.235	0.0070	4.6	900	1	0.112		1000	1	0.1	0		3	1003	1.220	2.10	0.32
65	900	1	0.2	0.075	0.0140	700	0	0.143	0.0160	9.8	900	0	0.125		950	0	0.1	0		2	670	1.340	2.85	0.43
66	1325	1	0.0	0.124	0.0320	1300	1	0.115	0.0530	7.0	1300	0	0.134	0.0240	1350	0	0.0	0	0.0320	3	660	1.316	2.80	0.19
67	1200	2	0.1	0.261	0.0100	1150	1	0.193	0.0310	16.1	1300	1	0.193	0.0130	1300	1	0.1	0	0.0130	5				0.16
68	825	1	0.2	0.111	0.0040	800	0	0.111	0.0004	2.6	800	0	0.129		875	1	0.0	0		5	1821	3.371	7.04	0.84
69	1000	0			0.0226	950	2		0.0194	13.8	380	0		0.0006						0	730	2.074	6.91	
50	620	0			0.0043	500	0		0.0046	2.7	450	0			700	0				0	463	1.542	3.76	
51	520	1				400	2			5.6	400	2			520	1				2	2456	4.097	9.02	0.74
52	1300	1		0.046	0.0006	620	1	0.091	0.0060	5.7	900	0	0.021	0.0002	1650	2			0.0037	1	293	0.696	1.63	0.27
53	410	0			0.0150	330	0		0.0140	1.1	290	0		0.0026	700	3			0.0014	1	1043	3.015	6.47	0.89
54	550	0	0.0		0.0017	450	0		0.0062	0.9	340	0		0.0012	480	0	0.0	0	0.0362	0	620	1.578	4.84	0.87
55	2000	1	0.0	0.215	0.0074	800	1	0.204	0.0269	12.5	1500	1	0.215	0.0044	1600	0	0.0	0	0.0264	1	682	2.411	6.29	0.37
56	3100	0	0.0	0.000	0.0256	3000	0	0.000	0.0286	7.6	3000	0	0.003	0.0269	3100	0	0.0	0	0.0233	2	369	1.205	3.04	0.03
57	1000	1	0.0	0.173	0.0070	900	0	0.167	0.0200	3.9	1000	1	0.166		1225	1	0.0	0		0	1253	4.463	9.34	0.42
58	1200	0	0.0	0.090	0.0020	1200	1	0.090	0.0010	4.8	1150	0	0.110		1200	0	0.0	0		0	875	3.035	7.47	0.36
59	1275	1	0.1	0.081	0.0110	1125	0	0.196	0.0260	4.1	1450	0	0.146	0.0140	1400	0	0.1	0	0.0110	0	793	2.009	3.66	0.21
60	700	0	0.0	0.050	0.0020					1.3	550	0	0.050	0.0010	800	0	0.0	0	0.0010	0	1447	5.368	15.17	1.35
61	840	0	0.0	0.009	0.0093	840	0	0.055	0.0157	2.6	800	0	0.009		1150	0	0.0	0	0.0002	2	436	1.551	6.45	0.24
62	900	0	0.0	0.106	0.0010	800	0	0.106	0.0020	2.4	900	0	0.166	0.0020	950	0	0.0	0	0.0020	0	616	2.026	6.07	0.19
63	1050	2	0.1	0.223	0.0050					2.8	1000	1	0.235	0.0030	1250	0	0.0	0	0.0030	0	1134	3.864	10.60	0.44
64	1100	1	0.1	0.193	0.0332	900	1	0.097	0.0477	8.0	1100	0	0.134	0.0360	1200	0	0.1	0	0.0360	0	513	1.947	5.02	0.19
65	1900	2	0.2	0.219	0.0240					6.6	1900	1	0.285		2200	1	0.0	0		1	443	2.116	8.61	0.25
66	1300	0	0.2		0.0070	1000	1		0.0100		1300	0			1250	0	0.1	0		2	548	1.594	3.60	0.32
67	350	1	0.0	0.000	0.0000	350	1	0.000	0.0000	6.5	300	0	0.000	0.0000	350	0	0.0	1	0.0000	1	2594	5.847	10.29	0.45
68	600	1	0.0	0.030	0.0000	350	1	0.124	0.0000	7.5	400	0	0.000	0.0000	450	0	0.0	1	0.0000	1	1711	4.849	9.05	0.23
69	500	3	0.0	0.000	0.0000	460	3	0.000	0.0001	1.5	500	3	0.020	0.0000	600	2	0.0	0	0.0000	2	499	1.364	3.59	0.16
70	1150	1	0.2	0.083	0.0120	750	1	0.033	0.0200	6.1	1100	1	0.046		1300	1	0.1	0		2	350	1.735	4.03	0.33
71	700	0	0.0	0.057	0.0037	600	0	0.090	0.0046	4.0	700	0	0.068	0.0024	830	0	0.0	6	0.0012	2	1484	2.596	5.10	
72	1400				0.0070				0.0352	11.2				0.0143					0.0234	5	389	1.090	2.10	0.14
73	1100	0	0.0	0.000	0.0150	950	2	0.040	0.0330	4.7	1100	1	0.048	0.0230	1100	1	0.0	0	0.0150	3	1256	1.799	2.69	0.04
74	710	1	0.0	0.100	0.0010	600	0	0.157	0.0030	1.1	700	1	0.124		800	0	0.0	0	0.0010	0	956	3.659	8.67	0.28
75	850	0	0.0	0.032	0.0010					5.0	725	0	0.040	0.0000	800	0	0.0	0	0.0000	2	776	2.297	7.74	0.35
76	625	0	0.0	0.115	0.0030	650	0	0.134	0.0010	3.6	650	0	0.173	0.0040	675	0	0.0	0	0.0030	1	1201	2.574	5.72	0.35
77	900	1	0.0	0.170	0.0050	800	0	0.153	0.0151	5.6	1100	0	0.144	0.0071	1150	1	0.0	0	0.0007	3	909	2.006	5.48	0.21
78	1300	1	0.0	0.204	0.0040	950	0	0.183	0.0000	3.2	1300	0	0.383	0.0030	1350	0	0.0	0	0.0030	0	835	3.049	7.45	0.22
COUNT	76	76	55	50	71	68	69	45	71	70	70	73	49	59	66	68	54	55	53	78	76	76	76	74
MEAN	885	0.7	0.05	0.090	0.0071	762	0.7	0.088	0.0123	4.5	825	0.4	0.092	0.0066	1000	0.6	0.03	0.3	0.0093	1.4	1038	2.904	6.84	0.29
STD	431	1.0	0.071	0.060	0.0101	374	0.9	0.064	0.0144	3.4	430	0.7	0.073	0.0101	430	0.9	0.04	1	0.0122	1.3	507	1.371	3.35	0.22
MAX	3100	4	0.2	0.261	0.0470	3000	4	0.235	0.0629	16.1	3000	3	0.285	0.0490	3100	5	0.1	6	0.0490	5	2594	6.266	15.95	1.35
MIN	350	0	0.0	0.000	0.0000	330	0	0.000	0.0000	0.8	290	0	0.000	0.0000	350	0	0.0	0	0.0000	0	293	0.696	1.63	0.00

TABLE 4.1 (cont'd)

I.D.	House Const. Date	A.B. OCCUPANTS CONCERN (0=N.1=Y)	CENSUS DISTRICT	NUMBER OF OCCUPANTS
1	1935	0	1	3
2	1952	1	1	3
3	1910	0	1	5
4	1930	0	1	6
5	1950	0	1	4
6	1924	0	1	5
7	1911	0	2	2
8	1912	1	2	6
9	1930	1	2	4
10	1942	1	2	3
11	1918	0	2	2
12	1922	0	2	2
13	1980	1	3	3
14	1922	0	3	4
15	1959	0	3	2
16	1960	0	3	5
17	1962	0	3	3
18	1964	0	3	3
19	1947	0	11	3
20	1948	1	4	2
21	1971	0	3	2
22	1955	0	4	4
23	1957	1	4	5
24	1917	0	5	5
25	1914	0	5	5
26	1955	0	5	1
27	1947	1	4	5
28	1906	0	5	4
29	1930	0	5	5
30	1950	1	4	3
31	1950	0	6	3
32	1957	0	6	1
33	1922	1	6	3
34	1944	0	6	2
35	1948	1	6	3
36	1952	0	6	3
37	1950	0	7	2
38	1946	1	7	3
39	1973	0	7	4
40	1912	0	7	3
41	1949	0	7	2
42	1920	0	7	2
43	1972	1	13	2

TABLE 4.1 (cont'd)

I.D.	House Const. Date	A.D. OCCUPANTS CONCERN (0=N,1=Y)	CENSUS DISTRICT	NUMBER OF OCCUPANTS
44	1962	0	12	4
45	1971	0	13	3
46	1969	1	13	7
47	1959	0	12	4
48	1956	1	12	2
49	1941	1	9	3
50	1948	1	9	2
51	1902	0	9	3
52	1962	1	9	2
53	1930	0	9	5
54	1950	0	9	2
55	1930	0	10	2
56	1944	1	10	3
57	1949	0	10	1
58	1950	1	10	2
59	1947	1	11	3
60	1947	1	11	1
61	1959	0	11	2
62	1940	1	11	1
63	1947	0	11	3
64	1957	0	4	1
65	1947	0	8	2
66	1972	0	8	4
67	1910	1	8	3
68	1932	0	8	2
69	1956	1	8	2
70	1957	1	8	4
71	1968	1	12	3
72	1974	1	12	4
73	1968	1	12	3
74	1918	1	10	1
75	1957	1	3	2
76	1976	1	12	4
77	1961	0	13	2
78	1946	0	13	1
COUNT	78	78	78	78
MEAN	1945	0.4		3
STD	19	0.5		1
MAX	1980	1		7
MIN	1902	0		1

4.4 Discussion of the Data

A survey of the data in Table 4.1 indicates that many houses have pollutant levels which are above normally accepted exposure guidelines.

The Exposure Guidelines produced by the Federal Provincial Advisory Committee on Environmental and Occupational Health in April 1987 (the Guidelines) specify an action level of 0.1 ppm for formaldehyde. The average level found in this study was 0.09 ppm, and many of the houses tested were above the action level.

The Guidelines specify an acceptable long-term exposure range (ALTER) of less than 40 mg/m^3 for respirable suspended particulates (RSP) and a short-term range (ASTER) of less than 100 mg/m^3. The instrument used in this study was not sensitive enough to detect RSP at 40 Mg/m^3, but it indicated twelve living rooms at around 100 Mg/m^3 and 8 living rooms at higher levels, out of 55 houses in which this measurement was made.

The U.S. Environmental Protection Agency recommends an action level of 4 pCi/L for radon. The average level found in the 70 houses surveyed in this study was slightly above this, at 4.5 pCi/L, and the highest level was 16.1 pCi/L, more than four times the EPA action level.

The levels of carbon monoxide, carbon dioxide and ozone were found to be below the limits set by the Guidelines in all the houses studied.

It should be noted that this study was carried out in July, August, September and October, when houses would be expected to be less tightly sealed than they would be in mid winter.

5.0 ANALYSIS OF THE DATA

The present project was directed at data collection, not data analysis. The project produced a large volume of data, including many pairs of variables which may be correlated in interesting ways. In this chapter, some of the possible studies which could be carried out using this data are described. Because the data is available on BOSS and LOTUS 123 data files, many of these correlations can be analyzed with very little effort. Some of these simple data sets which may produce interesting correlations are:

1. Construction date vs. air tightness,
2. Pollutant levels vs. infiltration rate,
3. Pollutant levels vs. airtightness,
4. CO_2 per occupant vs. infiltration rate,
5. CO_2 per occupant vs. airtightness,
6. Pollutant levels vs. age of house,
7. Pollutant levels vs. market value,
8. Air tightness vs. market value,
9. Infiltration vs. predicted infiltration (from air tightness and weather),
10. Inter-pollutant correlations (including moisture),
11. Perceived air quality problems vs. actual pollutant levels,
12. Formaldehyde vs. formaldehyde predictors (new rugs or furniture etc.),
13. Radon vs radon predictors,
14. Radon vs. census tract,
15. Fan noise complaints vs. fan noise,
16. Fan capacity and use vs. pollutants,
17. Fan noise vs. fan use,
18. Normalized energy consumption vs. (a) age
    (b) airtightness,
19. HOT-2000 prediction vs. energy consumption.

6.0 CONCLUSIONS

This study has produced a set of approximately 750 observations and measurements of characteristics of a set of 78 randomly selected Winnipeg houses.

This data is now available for researchers to use in studying the factors which influence air quality and energy use in houses.

APPENDIX A

PRELIMINARY LETTER TO HOUSEHOLDER

7215-100
LEADLETTER#3

JULY , 1987

Mrs. xx
Street Address
WINNIPEG, Manitoba
Postal Code

Dear:

We would like to include your house as part of a 100-house Winnipeg survey concerning indoor air quality. The objective of this report is to provide the federal government, which is funding this study, with information that will enable them to improve building legislation. All obtained information will be handled confidentially and your name and address will not be released.

This study is non-commercial and will not entail any costs or inconvenience. On the contrary, at the end of the study, you will be provided with a written report on the results of the measurements done in your house.

The following tests, which cost $500 to $1,000 when done commercially, will be conducted in your house at no cost to you:

1) measuring levels of pollutants such as CO_2, CO, and formaldehyde.
2) two separate measurements of the radioactive gas radon, which is present in Winnipeg houses and is the leading cause of lung cancer for non-smokers.
3) a blower-door test to determine the air tightness and energy efficiency of your home.
4) a complete energy analysis of your home using computer simulation.
5) ventilation fans can help to maintain indoor air quality, but they are frequently not used because householders object to the noise. One of the elements of this study will be an assessment of householder attitudes towards fan noise, their use of fans, and the noise generated by these fans.

In order to determine your energy consumption, we request your permission to contact ICG Utilities and Winnipeg/Manitoba Hydro (whichever applies) to obtain data pertaining to your gas or electricity use.

Should you wish to confirm the validity of our study, please call ENERGY MINES AND RESOURCES CANADA at 984-4266 between 8:00 a.m. and 4:00 p.m. (page 2 of the grey pages of the Winnipeg phone book).

This letter serves only as an introduction to our study. We are looking forward to meeting with you personally in the near future to discuss the details of the project and to answer any questions or concerns that you may have. One of our representatives will be contacting you shortly to arrange a meeting at your convenience. Please note that this service is being provided at no cost to you. Also, no testing will be performed without your written authorization.

Sincerely,

G. K. YUILL AND ASSOCIATES LTD.

Kelly Armstrong and Matthew Krause
KA:ka

APPENDIX B

COMPLETED SET OF SURVEY FORMS

HOMEOWNER SURVEY

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE
1. DATE: June 17, 1987	1.	—
2. START TIME: 10:30	2.	10 30
3. FINISHING TIME: 12:30	3.	12 30
4. CENSUS TRACT NUMBER: 3	4.	3
1 - 009.00 2 - 018.00 3 - 502.00 4 - 050.02 5 - 046.00 6 - 113.00 7 - 027.00 8 - 123.00 9 - 007.00 10 - 531.00 11 - 050.01 12 - 510.00 13 - 101.02		
OCCUPANT INFORMATION		
5. Occupant Name:	5.	
6. Address:	6.	
7. Telephone Number:	7.	
HOMEOWNER (If different from the occupant)		
8. Name:	8.	
9. Address:	9.	
10. Telephone Number:	10.	
11. Is this the original occupant? 1 - yes 2 - no	11.	1
12. Is the occupant the: 1 - owner 2 - renter 3 - owner/builder	12.	1
13. Was this house built as a custom home for the present homeowner? 1 - yes 2 - no 98 - don't know	13.	2

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE

14. What are the ages of each person living in the house and to how many days per week are they home? (on average) 27.

Age	Days/Week
14. 52	15. 2
16. 48	17. 5
18. 18	19. 2.5
20.	21.
22.	23.
24.	25.
26.	27.

14.	52
15.	2
16.	48
17.	5
18.	18
19.	2.5
20.	
21.	
22.	
23.	
24.	
25.	
26.	
27.	

28. What are the primary occupations of the occupant and the to spouse? 29.

28. Occupant

-1 - N/A
1 - Professional
2 - Manager/Admin.
3 - Technical
4 - Sales
5 - Clerical

29. Spouse

6 - Trades
7 - Homemaker
8 - Student
9 - Retired
10 - Civil Service
99 - Other: _____

28.	10
29.	14

30. What does the occupant feel will happen to energy prices in the future? (next 5 to 10 years)

1 - increase 2 - remain constant 3 - decrease
98 - don't know

30.	1

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE
31. For how many years do the occupants expect to own their home? 1 - 5 years or less 2 - 6 to 10 years 3 - 11 to 15 years 4 - more than 15 years 98 - don't know	31.	3
32. What is the approximate market value of your house? 1 - less than $50,000 2 - $50,000 to $100,000 3 - $100,000 to $175,000 4 - over $175,000	32.	2
ENERGY CONSUMPTION		
33. What is the approximate construction date of your house?	33.	1962
34. Keeping in mind the year that your house was built, how would you rate it's thermal quality? 1 - poor 2 - average 3 - good	34.	2
35. What is the predominant cladding on your house? 1 - stucco 2 - masonry 3 - metal siding 4 - wood 5 - vinyl siding 99 - other: _____	35.	1
36. Specify the type of insulation used in the exterior walls and in the attic. 37. 36. Walls 1 - __" Air space 2 - 4" Batt 3 - __" Foam 37. Attic 4 - __" Rigid 5 - 9" Cellulose 6 - __" Wood shavings	36. 37.	2 5

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE

Comments: List the building materials used in the exterior walls starting from the inside and working outward. (Specify the thicknesses also)

38. List any energy conservation features in your house.
to
42.

97 - none
1 - HRV
2 - Double pane windows
3 - Triple pane windows
4 - Weather stripping
5 - Extra wall insulation
6 - Extra ceiling insulation
7 - High efficiency furnace
8 - R-2000 house
99 - other: Will be installing tinted triple-pane windows in future

38.	6
39.	99
40.	
41.	
42.	

43. List the features inside the home which contribute to
to increased energy consumption.
47.

97 - none
1 - well pump
2 - sump pump
3 - sauna
4 - workshop
5 - indoor pool
6 - whirlpools
7 - energy intensive hobbies
8 - garbage compactor/shredder
9 - central vacuum
10 - open windows/doors
99 - other: _____

43.	9
44.	
45.	
46.	
47.	

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE

48. List the features outside the home which contribute to to increased energy consumption.
52.

97 - none
1 - outdoor pool
2 - electric gardening tools
3 - yard lighting
4 - separate workshop
5 - heated walk/driveway
99 - other: _____

48. 97
49.
50.
51.
52.

53. Does the occupant use a block heater?

1 - yes 2 - no

53. 1

54. Since the house has been occupied, are there areas attached to the home which were not previously heated, and are now heated?

97 - none
1 - addition
2 - garage
3 - sunspace
99 - other: _____

54. 97

INDOOR AIR QUALITY

55. Does the occupant have any concerns regarding the air quality in the home? (eg. moisture/humidity, dry static air, odors, or drafts)

1 - yes 2 - no

55. 2

IF THE ANSWER TO QUESTION 55 WAS YES, COMPLETE QUESTIONS 56 TO 81, OTHERWISE GO TO QUESTION 80.

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE

56. Identify any air quality concern(s) by indicating whether to or not the following occurs during the summer and/or winter.
91. Do not prompt the occupant.

1 - minor problem
2 - moderate problem
3 - severe problem
97 - no problem

Moisture/Humidity (56-67)

	SUMMER	WINTER
window panes, sills and trim	56.	57.
mildew in room ceiling corners	58.	59.
sensory perception of moisture	60.	61.
warped or swollen doors	62.	63.
damp basement floors or walls	64.	65.
other: _____	66.	67.

comments: _____

_____

56.
57.
58.
59.
60.
61.
62.
63.
64.
65.
66.
67.

Odours (68-73)

in the kitchen	68.	69.
in the bathroom	70.	71.
other: _____	72.	73.

comments: _____

_____

68.
69.
70.
71.
72.
73.

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE

Dry Static Air (74-79)

sensory perception
(eg. dry throat)
static electricity

other: _____

comments: _____

_____

74.	75.
76.	77.
78.	79.

74.
75.
76.
77.
78.
79.

Drafts (80-81)

80.	81.

80.
81.

82. Does the occupant have reason to believe that their home has higher or lower radon levels than an average home? Explain.

1 - yes 2 - no 82. 2

_____

_____

_____

83. Is the occupant aware of what factors might cause high radon levels in a house?

1 - yes 2 - no 83. 2

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE
84. Approximately how many cigarettes are smoked in the home per day?	84.	0
85. Are any pipes or cigars smoked in the home? 1 - yes 2 - no	85.	2
86. Approximately how many plants are in the home?	86.	3
87. Approximately how many of these are spider plants?	87.	1
NOTE: spider plants have the ability to absorb certain amounts of formaldehyde from the air.		
88. In the living room in which the formaldehyde dosimeter has to been located, identify items which could significantly 93. affect the formaldehyde readings.		
1 - new and/or newly upholstered furniture 2 - wall to wall carpets and/or rugs 3 - draperies 4 - cupboards 5 - wall panellings 6 - painting/wall papering 97 - nothing 99 - other: _____	88. 89. 90. 91. 92.	97
comments: _____	93.	
94. In the remote bedroom in which the formaldehyde dosimeter has to been located, identify items which could significantly 99. affect the formaldehyde readings.		
1 - new and/or newly upholstered furniture 2 - wall to wall carpets and/or rugs 3 - draperies 4 - cupboards 5 - wall panellings 6 - painting/wall papering 97 - nothing 99 - other: _____	94. 95. 96. 97. 98.	97
comments: _____	99.	

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE

100. In the basement in which the formaldehyde dosimeter has
to been located, identify items which could significantly
105. affect the formaldehyde readings.

1 - new and/or newly upholstered furniture
2 - wall to wall carpets and/or rugs
3 - draperies
4 - cupboards
5 - wall panellings
6 - painting/wall papering
97 - nothing
99 - other: _____

comments: _____

_____

100. 97
101.
102.
103.
104.
105.

106. List the occupant's hobbies that could effect the air
to quality in the home.
109.

97 - none
1 - pottery/crafts
2 - wood working
3 - mechanical work
4 - oil painting
5 - beer/wine making
6 - furniture refinishing
99 - other: _____
_____

106. 97
107.
108.
109.

110. What is the source for water used in this house?

1 - municipal water
2 - homeowner spring or surface well
3 - homeowner well deeper than 25 feet
99 - other: _____

110. 1

111. Where does the dryer vent?

-1 - N/A
1 - indoors
2 - outdoors
3 - indoors in winter/outdoors in summer
4 - directly to the HRV

111. 2

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE
112. If the dryer vents to the indoors, have extra lint screens been installed? -1 - N/A 1 - yes 2 - no	112.	-1
113. Is there a cooling/air conditioning system in the house? 1 - yes 2 - no	113.	1
114. Has a central electronic air cleaner been installed? 1 - yes 2 - no	114.	2
115. Has a central humidifier been installed? 1 - yes 2 - no	115.	2
116. Does this house have a forced air heating system? 1 - yes 2 - no	116.	1
117. If fresh air is distributed by the forced air heating system, does the furnace fan run continuously? -1 - N/A 1 - yes 2 - no	117.	1
118. Is the furnace fan multispeed? -1 - N/A 1 - yes 2 - no 98 - unable to determine	118.	1

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE

119. Indicate for the following zones of the house, the
to location of the cold air returns and the warm air
124. outlets.

-1 - N/A

1 - most returns/outlets are at the ceiling/ top of wall.

2 - most returns/outlets are at the base of wall/floor.

3 - the returns/outlets are uniformly located at the ceiling/top of wall and at the base of wall/floor.

4 - no return and/or outlets are located in this zone.

House Zone	Location of Cold Air Return	Location of Warm Air Supply
Basement Area	119. 2	120. 1
Living Area	121. 2	122. 2
Bedroom Area	123. 2	124. 2

	RES-PONSE CODE
119.	2
120.	1
121.	2
122.	2
123.	2
124.	2

If any of the supplies or returns are blocked, not this and their location: 1 in the bedroom because it is under the bed.

125. How many woodburning stoves/fireplaces are in the house? 125. 0

126. Specify the type of doors on the woodburning stove/fireplace.
to
128.

-1 - N/A
1 - glass
2 - airtight glass
3 - metal screen
4 - cast iron
5 - airtight cast iron
97 - none
99 - other: _____

126. -1
127.

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE
	128.	

129. Specify the type of combustion air supply for the fireplace/
to stove.
131.

-1 - N/A
2 - from living space
3 - from heated space other than living space
3 - from unheated space
4 - from outside

	129.	-1
	130.	
	131.	

132. How often does the occupant operate the following
to equipment?
139.

-1 - N/A
1 - continuously
2 - intermittantly
3 - never used

132. humidifier in winter	132.	-1
133. dehumidifier in summer	133.	-1
134. electronic air cleaning equipment	134.	-1
135. HRV in summer	135.	-1
136. HRV in winter	136.	-1
137. furnace blower - in winter	137.	1
138. furnace blower - in summer	138.	1
139. air conditioning	139.	2
140. fireplace/stove in winter	140.	-1
141. fireplace/stove in summer	141.	-1

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE

142. Do/Could any of the following factors impact upon the air to quality of the environment where the house is located?
144.

1 - main traffic thoroughfares — 142. 2
2 - light industries
3 - heavy industries (pulp & paper, oil refineries, steel mills, coal burning hydro, smelting, etc.) — 143.
4 - high concentration of residential wood burning stoves
5 - oceans, rivers, lakes
6 - agricultural activities — 144.
97 - none of these factors
99 - other: _____

comments: Kingston Airport Refinery

FAN INFORMATION

145. How often do you use this fan?
to
149.

145. FAN#1
146. FAN#2
147. FAN#3
148. FAN#4
149. FAN#5

145. 3
146. 3
147.
148.
149.

1 - never use
2 - less than ½ hour per day
3 - ½ to 2 hours per day
4 - over 2 hours per day but not continuously
5 - continuously

IF YOU USE YOUR FANS REGULARLY GO TO QUESTION 155.,
OTHERWISE CONTINUE ON WITH QUESTION 150.

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE

150. State the reason(s) for not using your fan(s) regularly.
to
154.

150. FAN#1
151. FAN#2
152. FAN#3
153. FAN#4
154. FAN#5

-1 - N/A
1 - does not adequately serve its purpose
2 - too noisy
3 - broken
99 - other: _____

150.	-1
151.	-1
152.	
153.	
154.	

COMMENTS: _____

_____

_____

155. How disturbing do you find the fan noise in the room it
to is located in?
159.

155. FAN#1
156. FAN#2
157. FAN#3
158. FAN#4
159. FAN#5

1 - not at all
2 - mildly disturbing
3 - moderately disturbing
4 - very disturbing

155.	4
156.	3
157.	
158.	
159.	

HOMEOWNER SURVEY	HOUSE I.D. 17	RES-PONSE CODE

160. How disturbing do you find the fan noise in the living to space?
165.

160. FAN#1
161. FAN#2
162. FAN#3
163. FAN#4
164. FAN#5
165. FURNACE FAN

1 - not at all
2 - mildly disturbing
3 - moderately disturbing
4 - very disturbing

160.	4
161.	2
162.	
163.	
164.	
165.	

166. How disturbing do you find the furnace fan noise at night when you are sleeping?

1 - not at all
2 - mildly disturbing
3 - moderately disturbing
4 - very disturbing

166.	1

TECHNICAL SURVEY

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE

VISUAL ASSESSMENT OF THE HOUSE

200. Building Height? (m) — 200. | 3.7

201. Terrain Class?

1 - Ocean or other body of water with at least 5 km of unrestricted expanse.

2 - Flat terrain with some isolated obstacles (eg., buildings or trees well separated from each other)

3 - Rural areas with low buildings, trees, etc.

4 - Urban, industrial or forest areas

5 - Center of large city — 201. | 4

202. Shielding Class?

1 - No obstructions (trees, fences, nearby houses) whatsoever.

2 - Light local shielding with few obstructions.

3 - Some obstructions within two house heights.

4 - Obstructions around most of perimeter.

5 - Large obstruction surrounding perimeter within two house heights. — 202. | 3

203. What material is the subfloor made of?

-1 - N/A
1 - plywood
2 - compostion board
3 - tongue and groove board
98 - unable to determine
99 - other: _____ — 203. | 1

204. What percentage of the basement is finished "living" space? — 204. | 50%

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE

205. Indicate which, if any, of the Space Heating, Cooling,
to Ventilating and/or Domestic Hot Water (DHW) systems
207. are combined.

1 - Heating, Cooling
2 - Heating, Cooling, Ventilating
3 - Heating, Cooling, Ventilating, and DHW
4 - Heating, Cooling, DHW

5 - Heating, Ventilating
6 - Heating, Ventilating, DHW
7 - Heating, DHW

8 - Cooling, Ventilating
9 - Cooling, Ventilating, DHW
10 - Cooling, DHW

11 - Ventilating, DHW

97 - none
99 - other: _____

205. 1
206.
207.

NOTE: For the purposes of this question do not consider the use of the furnace fan to distribute ventilation air as an integrated mechanical system.

Comments: _____

_____

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE

SPACE HEATING SYSTEMS

208. The following table will provide a complete description of
to the space heating systems installed in the house. One primary
223. and one secondary space heating systems may be described.

	PRIMARY	SECONDARY
A. Type	208. 2	216.
B. Manufacturer	209. General Steel Wares	217.
C. Model	210. EG 112 H-1	218.
D. Fuel	211. 5	219.
E. Input Capacity	212. 112000 Btu 32.8 KW	220.
F. Location of Appliance	213. 9	221.
G. Type of Fresh Air Inlet	214. -1	222.
H. Heat Distribution	215. 1	223.

208.	2
209.	xxxx
210.	xxxx
211.	5
212.	xxxx
213.	9
214.	-1
215.	1
216.	
217.	xxxx
218.	xxxx
219.	
220.	xxxx
221.	
222.	
223.	

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE

CODED TABLES FOR A, D, F, G

A. TYPE

-1 - N/A

Electric Space Heating

1 - Baseboard/hydronic/plenum (duct) heater
2 - Forced - air furnace
3 - Heat pump
4 - Radiant

Gas/Propane Space Heating Furnace/Boiler

5 - Conventional with pilot
6 - Conventional with spark ignition
7 - Conventional with spark ignition and vent damper
8 - Induced draft fan
9 - Condensing and pulse

Oil Space Heating Furnace/Boiler

10 - Conventional
11 - Conventional with flue damper
12 - Conventional with flame retention head
13 - Mid-efficiency (no dilution air)
14 - Condensing (no chimney)

Wood/Solid Fuel Space Heating

15 - Airtight wood stove
16 - Airtight wood stove with catalytic converter
17 - Wood/Solid fuel furnace
18 - Fireplace

Other Space Heating

19 - Solar Collector System

D. FUEL

1 - electric
2 - gas
3 - propane
4 - oil
5 - solar
6 - coal
7 - wood
8 - kerosene
9 - other: _____

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE

F. LOCATION OF APPLIANCE

Heated Area
1 - garage
2 - crawlspace
3 - attic

Unheated Area
4 - garage
5 - crawlspace
6 - attic

7 - furnace room
8 - utility room
9 - laundry room
10 - unpartitioned basement
11 - throughout house
12 - other: _____

G. TYPE OF FRESH AIR INLET

-1 - N/A
1 - return air duct
2 - wall opening or pipe
3 - combustion air supply
4 - fan powered

H. HEAT DISTRIBUTION

1 - forced air circulation
2 - free air circulation
3 - hydronic
4 - radiant

224. Chimney type?

1 - B-vent
2 - A-vent
3 - masonry
4 - masonry with liner

224. 2

225. Location of chimney?

1 - interior
2 - exterior

225. 1

226. Chimney diameter? (cm)

226. 15

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE

COOLING/AIR CONDITIONING SYSTEM

IF THERE IS NO COOLING/AIR CONDITIONING SYSTEM IN THE HOUSE, GO TO QUESTION 233.

227. to 232. The following table will provide a complete description of the cooling/air conditioning systems installed in the house.

ITEM	AIR CONDITIONING SYSTEM		RES-PONSE CODE
A. Type	227. 1	227.	1
B. Manufacturer	228. Keeprite	228.	xxxx
C. Model	229. SSC - 24 - 1D	229.	xxxx
D. Cooling Capacity (kW)	230. 24000 Btu/hr 7.04	230.	xxxx
E. Number of Window Cooling Units	231. 0	231.	0
F. Average Capacity of Window Units (kW)	232. 0	232.	xxxx

CODE TABLE FOR ITEM A.

A. TYPE

1 - central conventional
2 - window unit
3 - central heat pump
4 - none

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE

DOMESTIC HOT WATER SYSTEM

233. Does the hot water heater share the same chimney with the space heating unit?

-1 - N/A 1 - yes 2 - no 233. 1

234. Are the hot water pipes insulated?

-1 - N/A 1 - yes 2 - no 234. 2

235. The following table will provide a complete description of the
to domestic hot heating systems installed in the house. Up to
248. two DHW systems may be described.

	Primary	Secondary
A. Type	235. 7	242.
B. Fuel	236. 2	243.
C. Manufacturer	237. Rheem	244.
D. Model	238. RG40-36M	245.
E. Tank Size (L)	239. 30 US gal	246.
F. Input Capacity (W)	240. 36 000 Btu/hr 10.5 KW	247.
G. Insulation (mm)	241. 5	248.

235.	7
236	2
237.	xxxx
238.	xxxx
239.	112
240.	105
241.	5
242.	
243.	
244.	xxxx
245.	xxxx
246.	
247.	
248.	

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE

CODE TABLES FOR A & B

A. TYPE

-1 - N/A

Electric Hot Water Heater

1 - tank
2 - heat pump system
3 - tankless coil
4 - instantaneous (point of use)

Oil-Fired Hot Water Heater

5 - conventional tank
6 - tankless coil

Gas/Propane Hot Water Heater

7 - conventional tank
8 - tankless coil
9 - instantaneous (point of use)
10 - induced draft fan
11 - direct vent (sealed)

Other Hot Water Heaters

12 - fireplace or wood stove water coil
13 - solar collector system

B. FUEL

1 - electric
2 - gas
3 - propane
4 - oil
5 - solar
6 - coal
7 - wood
8 - kerosene
9 - other: _____

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE

VENTILATION SYSTEM

249. The following table will provide a complete description of
to the ventilation systems installed in the house.
251.

	VENTILATION SYSTEM		
A. Type	249.	249.	
B. Manufacturer	250.	250.	xxxx
C. Model	251.	251.	xxxx
D. Serial Number	252.	252.	xxxx
E. Location of Unit	253.	253.	

CODE TABLE FOR ITMES A & E

A. Type

1 - Heat Recovery Ventilator (HRV)
2 - Heat Pump
3 - Whole House Ventilator
99 - other: _____

E. Location of Unit

1 - Basement
2 - Main (ground) Floor
3 - 2nd floor

Heated Area

4 - garage
5 - crawlspace
6 - attic
7 - other: _____

Unheated Area

8 - garage
9 - crawlspace
10 - attic

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE

VENTILATION UNIT

254. Is there a flow measuring station (PBK) installed on the fresh/stale air duct?

-1 - N/A 1 - yes 2 - no 254. -1

255. Is there a means for balancing the HRV?

-1 - N/A 1 - yes 2 - no 255. -1

256. Is there insulation and a continuous vapour barrier on the HRV supply and exhaust air ducts, between the HRV and the exterior wall?

-1 - N/A 1 - yes 2 - no 98 - unable to determine 256. -1

257. Are the joints on the HRV warm side supply air and exhaust air ducts taped?

-1 - N/A 1 - yes 2 - no 98 - unable to determine 257. -1

258. Is a condensate hose installed?

-1 - N/A 1 - yes 2 - no 258. -1

Comments: _____

_____

259. Are vibration mounts installed for the HRV?

-1 - N/A 1 - yes 2 - no 259. -1

260. Are flexible connectors installed on the warm side of the HRV?

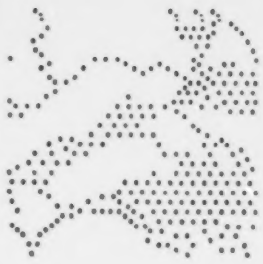
-1 - N/A 1 - yes 2 - no 260. -1

261. If there are filters on the exhaust ductwork are they clean?

-1 - N/A 1 - yes 2 - no 261. -1

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE
262. Is the HRV marked to identify the need for regular cleaning of the air filters? -1 - N/A 1 - yes 2 - no	262.	-1
263. Is the installer's name and/or phone number attached to the HRV? -1 - N/A 1 - yes 2 - no	263.	-1
264. Does the mechanical system(s) appear to vibrate or make noise that travels to the living and sleeping areas of the house? 1 - yes 2 - no	264.	—
Comments: _____		
OUTSIDE-HRV INLET & OUTLET		
265. Are bird screens (1/4 x 1/4 inch) installed on all outside exhaust and intake duct openings? -1 - N/A 1 - yes 2 - no	265.	-1
266. Are the bird screens clean? -1 - N/A 1 - yes 2 - no	266.	-1
267. Is the air intake hood located away from possible pollution sources (e.g. car exhaust, side wall vents, etc.)? -1 - N/A 1 - yes 2 - no	267.	-1
268. Are the exterior air intake and exhaust hoods at least 6 feet apart? -1 - N/A 1 - yes 2 - no	268.	-1
269. Is the fresh air intake hood a minimum of 18" above grade and clearly identified? -1 - N/A 1 - yes 2 - no	269.	-1
Comments: _____		

TECHNICAL SURVEY	HOUSE I.D. 17	RES-PONSE CODE
ROOF		
270. Estimate the roof pitch:	270.	25°
271. In what direction does the roof apex run? -1 - N/A (if flat roof) 2 - East-West 1 - North-South 3 - other: _____	271.	1



INDOOR AIR QUALITY SURVEY

AIR QUALITY SURVEY	HOUSE I.D. 17	RES-PONSE CODE

RADON LEVEL TESTS

300. The following table will provide information on the sources to of radon/soil gas entry into the House when the house 307. experiences negative pressures. With the house in winter operating condition, a negative pressure is created by turning on the clothes dryer if it is exterior vented. In its absence, the HRV is turned on high and the intake is blocked for the duration of the test.

-1 - N/A 1 - yes 2 - no

Potential Source for Radon/Soil Gas Entry Into House	During the test does the smoke pencil indicate gas entry?	
Floor drains as found	300. 1	300.
Floor drains with water added	301. -1	301.
Cracks in basement wall or floor	302. -1	302.
Domestic water entry	303. 2	303.
Sewage line leaving house	304. 2	304.
Sump hole	305. -1	305.
Other: windows basement	306. 1	306.
Other:	307.	307.

Comments:

AIR QUALITY SURVEY	HOUSE I.D. 17	RES-PONSE CODE

INSTANTANEOUS RADON MEASUREMENTS

The following table will provide information on the instantaneous radon measurements.

Meas. Site	Stop Time	Analysis Time	Scintillation Counts
1. Living Room	9:44	10:30	12, 8, 9, 8
2. Base-ment			
3. Remote Bedroom			
4. During TC test			

RADON COLLECTOR

309. Number 10544 — 309. 10544

310. Location 1 — 310. 1

1 - finished basement
2 - unpartioned basement
3 - unheated crawlspace
4 - heated crawlspace
5 - furnace room
6 - utility room
7 - laundry room
8 - living room
9 - bedroom
10 - kitchen
99 - other: _____

311. Start Date June 17 Start Time 10:40 — 311. xxxx

312. End Date June 24 End Time 9:25 — 312. xxxx

Comments _____

AIR QUALITY SURVEY	HOUSE I.D. 17	RES-PONSE CODE

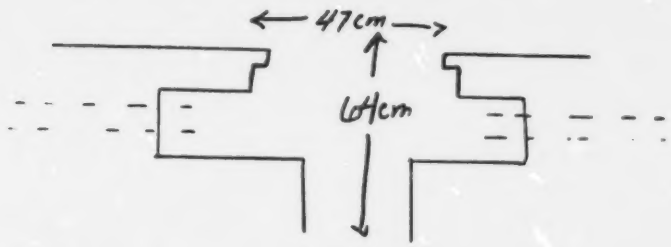
RELEVANT INFORMATION

313. What percentage of the time was the window open during the test? — 313. 10

314. What percentage of the time is the window usually open? — 314. 10

315. Average indoor temperature of the collector? (°C) — 315. 20

Sketch the verical section of the drain:



316. Specify the type of drain cover and sump cover.
to
317. 316. drain 317. sump

-1 - N/A
97 - none
1 - perforated cast iron
2 - solid cast iron
3 - wood
4 - sealed wood
5 - plastic
99 - other: _____

316. 1

317. -1

318. Specify the drain and sump diameters in cm.
to
319. 318. drain 319. sump

318. 47
319. —

320. What is the shape of the drain and sump?
to
321. 320. drain 321. sump

-1 - N/A
1 - round
2 - square
99 - other: _____

320. 1
321. —

322. Specify the depth of the drain and sump in cm.
to
323. 322. drain 323. sump

322. 64
323. —

AIR QUALITY SURVEY	HOUSE I.D. 17	RES-PONSE CODE

FORMALDEHYDE LEVEL MEASUREMENTS

324. During the time that the formaldehyde sampler is to be installed, will there be any smokers living in the house?

1 - yes 2 - no

324. 2

325. to 329. The following table will provide information on the cabinetry in the house which could give off formaldehyde gas. Record the approximate linear feet of the upper and lower cabinets measured separately. Do not include any cupboards, vanities, etc. that are constructed entirely of solid wood.

Location/Type	Approximate Linear Meter		RES-PONSE CODE
Kitchen: upper & lower	325.	4	325. 4
Bathroom counters	326.	1.5	326. 1.5
Other: _____	327.	\	327. —
Other: _____	328.	—	328. —
Total	329.	5.5	329. 5.5

The following table will provide information on the sampling times and colorimeter readings for each formaldehyde sampler.

Sample No.	Meas. Site	Start Time	Stop Time	Colorimeter Reading %
1. Living Room	1			
2. Basement	2	2:30	4:40	
3. Remote Bedroom	3	2:30	4:40	
4. Other: _____				

AIR QUALITY SURVEY	HOUSE I.D. 17	RES-PONSE CODE

INDOOR AIR QUALITY DATA (330 to 353)

The pollutant measurements are to be taken in the living room, basement and a remote bedroom <u>before</u> the tracer gas test and once again in the living room <u>during</u> the tracer gas test (TG test).

Pollutant		Measurement Site				
		1. Living Room	2. Basement	3. Remote Bedroom	1. During TG test	
CO_2	ppm	330. 575	336. 475	342.	348. 1550	
CO	ppm	331. 2	337. 2	343.	349. 2	
Formaldehyde	ppm	332. 0.323	338. 0.34	344.	350. 0.18	
VOC(2)	ppm	333.	339.	345.	351. xxxx	
Radon (inst)	WL	334.	340. 0.006	346.	352. 0.00634	
Radon (week)	pCi/L	335. xxxx	341. 4	347. xxxx	353. xxxx	

(2) Volatile Organic Compounds - all measurements done during tracer gas test.

330. 575
331. 2
332. 0.34
333. —
334. —
335. xxxx
336. 475
337. 2
338. 0.34
339. —
340. 0.00
341. 4
342.
343.
344.
345.
346.
347. xxxx
348. 1550
349. 2
350. 0.18
351. xxxx
352. 0.00634
353. xxxx

TRACER GAS TEST (354 to 360)

Date: _____

Start Time: _____

Measurement Site	SF_6 Concentration Time (minutes)						
	0	10	20	30	40	50	60
	354.	355.	356.	357.	358.	359.	360.

354.
355.
356.
357.
358.
359.
360.

AIR QUALITY SURVEY	HOUSE I.D. 17	RES-PONSE CODE

TEMPERATURE AND HUMIDITY TESTS

361. to 372. The following table will provide a complete description of the temperatures and humidity levels in the house.

Location: Zone	Wet Bulb Temp.	Dry Bulb Temp.	Relative Humidity
Outdoors	15	361. 19	362. 63
Basement	18	363. 21	364. 72
Main Floor	18	365. 23	366. 58
Second Floor		367.	368.
Third Floor		369.	370.
Other: _____		371.	372.

361.	19
362.	63
363.	21
364.	72
365.	23
366.	58
367.	
368.	
369.	
370.	
371.	
372.	

Comments: _____

WEATHER CONDITIONS

373. Barometric Pressure: 101.90 kPa

374. Wind Speed: 15 km/hr

375. Specify the weather conditions:

1 - sunny
2 - partly cloudy
3 - cloudy
4 - precipitation
99 - other: _____

373.	101.90
374.	15
375.	2

FAN NOISE SURVEY

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

400. The following table will provide a complete description of
to the fans installed in the house. Up to five fans may be
489. described.

Information Required	FAN#1	FAN#2	FAN#3	FAN#4	FAN#5
A. Fan Type	400. 1	418. 1	436.	454.	472.
B. Blade Type	401. 1	419. 1	437.	455.	473.
C. Room the fan is located in	402. 4	420. 6	438.	456.	474.
D. Fan rating CFM (if known)	403. —	421. —	439.	457.	475.
E. Control Type	404. 1	422. 1	440.	458.	476.
F. Manu-facturer	405. unknown	423.	441.	459.	477.
G. Fan diameter (cm)	406. 20.32	424. 20.32	442.	460.	478.
H. Rated power (W)	407. 1.5A	425. 1.5A	443.	461.	479.
I. Rated speed (rpm)	408. 1050	426. 1050	444.	462.	480.

400. 1
401. 1
402. 4
403. —
404. 1
405. xxxx
406. 20
407. 1.5
408. 1050
418. 1
419. 1
420. 4
421. —
422. 1
423. xxxx
424. 20
425. 1.5
426. 1050
436.
437.
438.
439.
440.
441. xxxx
442.
443.
444.
454.
455.
456.
457.
458. xxxx
459.
460.
461.
462.
472.
473.
474.
475.
476. xxxx
477.
478.
489.
480.

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

CONTINUATION OF FAN TABLE

Information Required	FAN#1	FAN#2	FAN#3	FAN#4	FAN#5
J. Mounting Height (m)	409. 2.44	427. 2.44	445.	463.	481.
K. Duct Type	410. 1	428. 1	446.	464.	482.
L. Duct Length (m)	411. 1.8	429. 1.8	447.	465.	483.
M. Duct Diameter (cm)	412. 7.5	430. 7.5	448.	466.	484.
N. Screens/ Louvres	413. 1	431. 1	449.	467.	485.
O. Dampers	414. 1	432. 1	450.	468.	486.
P. Purpose	415. 1,2,3	433. 1	451.	469.	487.
R. Sound Rating (if spec.)	416. —	434. —	452.	470.	488.

409. 2.44
410. 1
411. 1.8
412. 7.5
413. 1
414. 1
415. 1,2,3
416. —

427. 2.44
428. 1
429. 1.8
430. 7.5
431. 1
432. 1
433. 1
434. —

445.
446.
447.
448.
449.
450.
451.
452.

463.
464.
465.
466.
467.
468
469.
470.

481.
482.
483.
484.
485.
486.
487.
488.

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

CODES FOR ITEMS A,B,C,E,K,N,O,P

A. FAN TYPE

1 - exhaust:no filter
2 - exhaust with filter
2 - circulation:no filter
4 - circulation with filter

B. BLADE TYPE

1 - axial
2 - centrifugal

C. ROOM FAN IS LOCATED IN

1 - workshop
2 - utility
3 - laundry
4 - kitchen
5 - studio/hobby
6 - bathroom
99 - other:_____

E. CONTROL TYPE

1 - manual on/off switch
2 - manual lightswitch control
3 - manual high/low switch
4 - interval timer
5 - manual variable speed switch
6 - humidistat
7 - thermostat
99 - other:_____

K. DUCT TYPE

1 - metal
2 - flexible plastic
3 - rigid plastic

N. SCREENS/LOURVRES

1 - yes
2 - no

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

O. DAMPERS

1 - yes 2 - no

P. PURPOSE (answer one or more of the following)

1 - remove moisture
2 - remove odors
3 - remove heat
99 - other: _____

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

NOISE MEASUREMENTS

500. Fan Number: 1 — 500. 1

501. Measurement Site: 4 — 501. 1

502. List the predominant finishes in the room.
to
504.

502. floor 503. walls 504. ceiling

1 - drywall and paint/wallpaper
2 - stipple
3 - acoustic tile
4 - wood
5 - masonry
6 - ceramic tile
7 - linoleum
8 - carpet
99 - other: _____

502. 7
503. 1
504. 1

505. The following table will provide sound level measurements
to for the above fan.
516.

Preferred Frequency (Hz)

	63	125	250	500	1 K	2 K	4 K	8 K	16 K	A	LIN
Background Noise	40	35	44	30	30	24	30	20	20	32	57
Total Reading	60	54	64	63	56	51	46	34	27	72	71
Corrected Level	60	54	64	62	56	51	46	34	27	72	71
	505	506	507	508	509	510	511	512	513	514	515

505. 60
506. 54
507. 64
508. 63
509. 56
510. 51
511. 46
512. 34
513. 27
514. 72
515. 71

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

NOISE MEASUREMENTS

600. Fan Number: 2

601. Measurement Site: 5

602. List the predominant finishes in the room.
to
604.

602. floor 603. walls 604. ceiling

1 - drywall and paint/wallpaper
2 - stipple
3 - acoustic tile
4 - wood
5 - masonry
6 - ceramic tile
7 - linoleum
8 - carpet
99 - other: _____

605. The following table will provide sound level measurements
to for the above fan.
616.

Preferred Frequency (Hz)

	63	125	250	500	1 K	2 K	4 K	8 K	16 K	A	LIN
Background Noise	37	40	31	30	30	20	<20	<20	<20	34	42
Total Reading	55	61	59	61	53	49	50	42	25	31	72
Corrected Level	55	61	59	61	53	49	50	42	25	31	72
	605	606	607	608	609	610	611	612	613	614	615

	RES-PONSE
600.	2
601.	5
602.	7
603.	1
604.	1
605.	55
606.	61
607.	59
608.	61
609.	53
610.	49
611.	50
612.	42
613.	25
614.	61
615.	72

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

NOISE MEASUREMENTS

700. Fan Number: _____ 700.

701. Measurement Site: _____ 701.

702. List the predominant finishes in the room.
to
704.

702. floor 703. walls 704. ceiling

1 - drywall and paint/wallpaper
2 - stipple
3 - acoustic tile
4 - wood
5 - masonry
6 - ceramic tile
7 - linoleum
8 - carpet
99 - other: _____

702.
703.
704.

705. The following table will provide sound level measurements
to for the above fan.
716.

Preferred Frequency (Hz)

	63	125	250	500	1 K	2 K	4 K	8 K	16 K	A	LIN
Background Noise											
Total Reading											
Corrected Level											
	705	706	707	708	709	710	711	712	713	714	715

705.
706.
707.
708.
709.
710.
711.
712.
713.
714.
715.

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

NOISE MEASUREMENTS

800. Fan Number: _____ 800.

801. Measurement Site: _____ 801.

802. List the predominant finishes in the room.
to
804.

802. floor 803. walls 804. ceiling

1 - drywall and paint/wallpaper
2 - stipple
3 - acoustic tile
4 - wood
5 - masonry
6 - ceramic tile
7 - linoleum
8 - carpet
99 - other: _____

802.
803.
804.

805. The following table will provide sound level measurements
to for the above fan.
816.

Preferred Frequency (Hz)

	63	125	250	500	1 K	2 K	4 K	8 K	16 K	A	LIN
Background Noise											
Total Reading											
Corrected Level											
	805	806	807	808	809	810	811	812	813	814	815

805.
806.
807.
808.
809.
810.
811.
812.
813.
814.
815.

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

NOISE MEASUREMENTS

900. Fan Number: _____ 900.

901. Measurement Site: _____ 901.

902. List the predominant finishes in the room.
to
904.

902. floor 903. walls 904. ceiling

1 - drywall and paint/wallpaper
2 - stipple
3 - acoustic tile
4 - wood
5 - masonry
6 - ceramic tile
7 - linoleum
8 - carpet
99 - other: _____

902.
903.
904.

905. The following table will provide sound level measurements
to for the above fan.
916.

Preferred Frequency (Hz)

	63	125	250	500	1 K	2 K	4 K	8 K	16 K	A	LIN
Background Noise											
Total Reading											
Corrected Level											
	905	906	907	908	909	910	911	912	913	914	915

905.
906.
907.
908.
909.
910.
911.
912.
913.
914.
915.

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

LIVING SPACE SOUND LEVEL MEASUREMENTS

950. Measurement Site: _____ 950.

951. List the predominant finishes in the room.
to
953.

951. floor 952. walls 953. ceiling

1 - drywall and paint/wallpaper
2 - stipple
3 - acoustic tile
4 - wood
5 - masonry
6 - ceramic tile
7 - linoleum
8 - carpet
99 - other: _____

951.

952.

953.

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

Preferred Frequency (Hz)

	63	125	250	500	1 K	2 K	4 K	8 K	16 K	A	LIN
Indoor Background Noise											
Fan1 Total Reading											
Corrected Level	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010
Fan2 Total Reading											
Corrected Level	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021
Fan3 Total Reading											
Corrected Level	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032
Fan4 Total Reading											
Corrected Level	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043
Fan5 Total Reading											
Corrected Level	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

Preferred Frequency (Hz)

	63	125	250	500	1 K	2 K	4 K	8 K	16 K	A	LIN
Outside Background Noise											
Outside Tot Furnace Noise											
Corrected Outside Furnace Noise	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065
Inside Total Furnace Noise											
Corrected Inside Furnace Noise	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076
Total Noise of all fans at once											
Corrected Total Fan Noise	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087
Other:											
	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098
Other:											
	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109

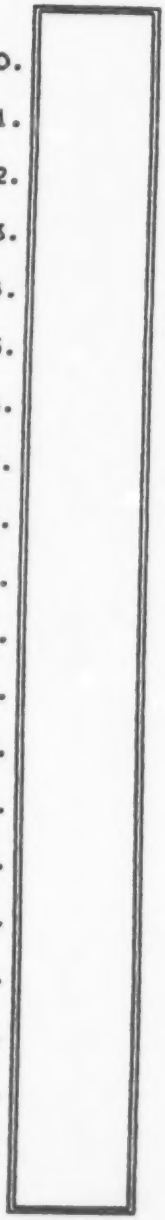
FAN SURVEY	HOUSE I.D. 17	RES-PONSE

RESPONSES

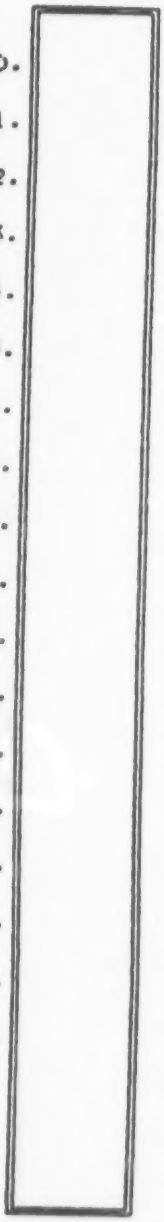
1000.	1020.	1040.
1001.	1021.	1041.
1002.	1022.	1042.
1003.	1023.	1043.
1004.	1024.	1044.
1005.	1025.	1045.
1006.	1026.	1046.
1007.	1027.	1047.
1008.	1028.	1048.
1009.	1029.	1049.
1010.	1030.	1050.
1011.	1031.	1051.
1012.	1032.	1052.
1013.	1033.	1053.
1014.	1034.	1054.
1015.	1035.	1055.
1016.	1036.	1056.
1017.	1037.	1057.
1018.	1038.	1058.
1019.	1039.	1059.

FAN SURVEY	HOUSE I.D. 17	RES-PONSE

RESPONSES



1060.
1061.
1062.
1063.
1064.
1065.
1066.
1067.
1068.
1069.
1070.
1071.
1072.
1073.
1074.
1075.
1076.
1077.
1078.
1079.



1080.
1081.
1082.
1083.
1084.
1085.
1086.
1087.
1088.
1089.
1090.
1091.
1092.
1093.
1094.
1095.
1096.
1097.
1098.
1099.

1100.
1101.
1102.
1103.
1104.
1105.
1106.
1107.
1108.
1109.
1110.

MEASUREMENT SITES

MEASUREMENT SITES	HOUSE I.D. 17

LEGEND

CO - carbon monoxide

CO2 - carbon dioxide

F - formaldehyde

RC - radon canistor

RI - radon instantaneous

NOx - oxides of nitrogen

VOC - volatile organic compounds

mic - microphone position

fan - fan location

MEASUREMENT SITES

HOUSE I.D. 17

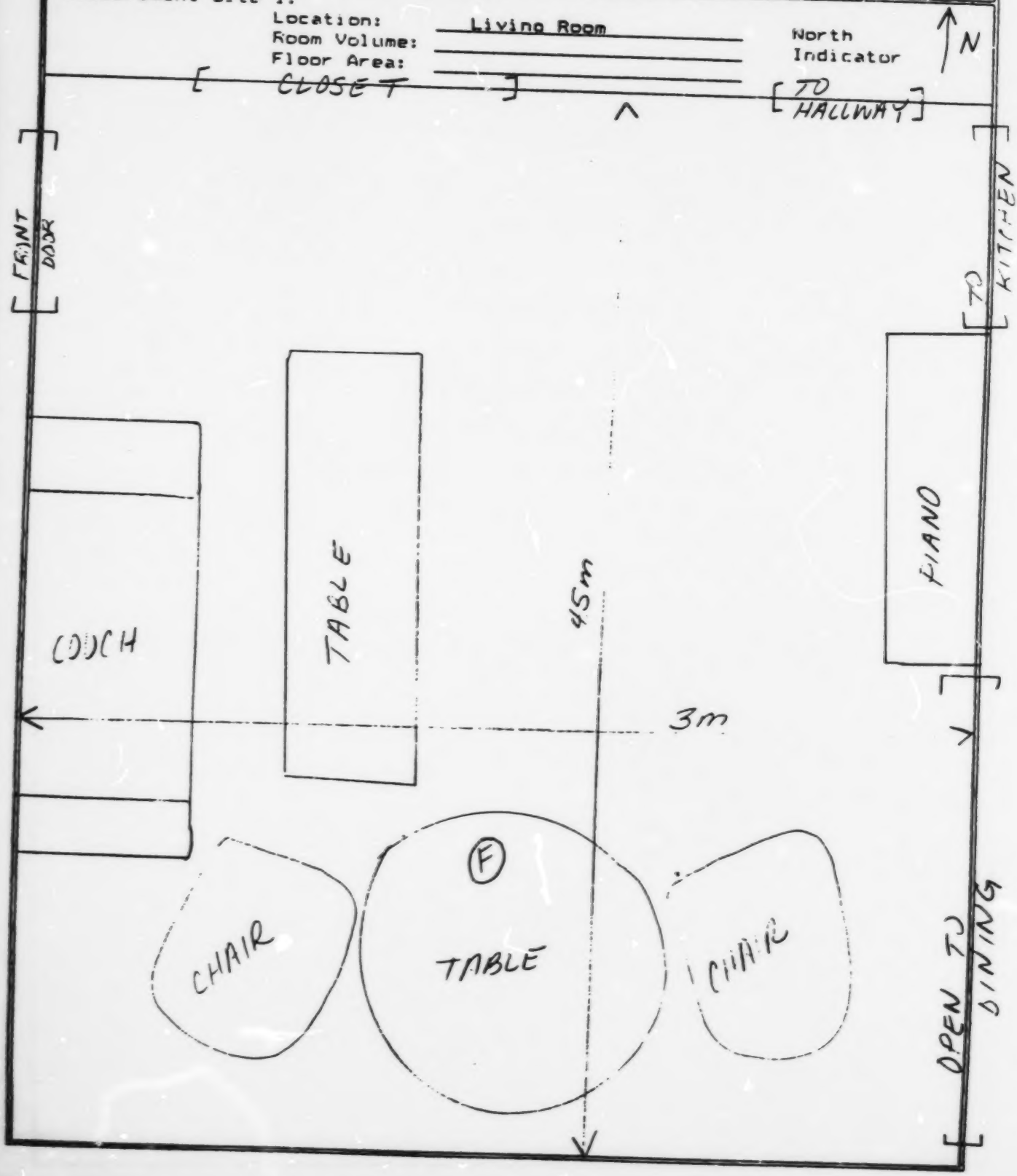
Measurement Site 1:

Location: Living Room

Room Volume:

Floor Area:

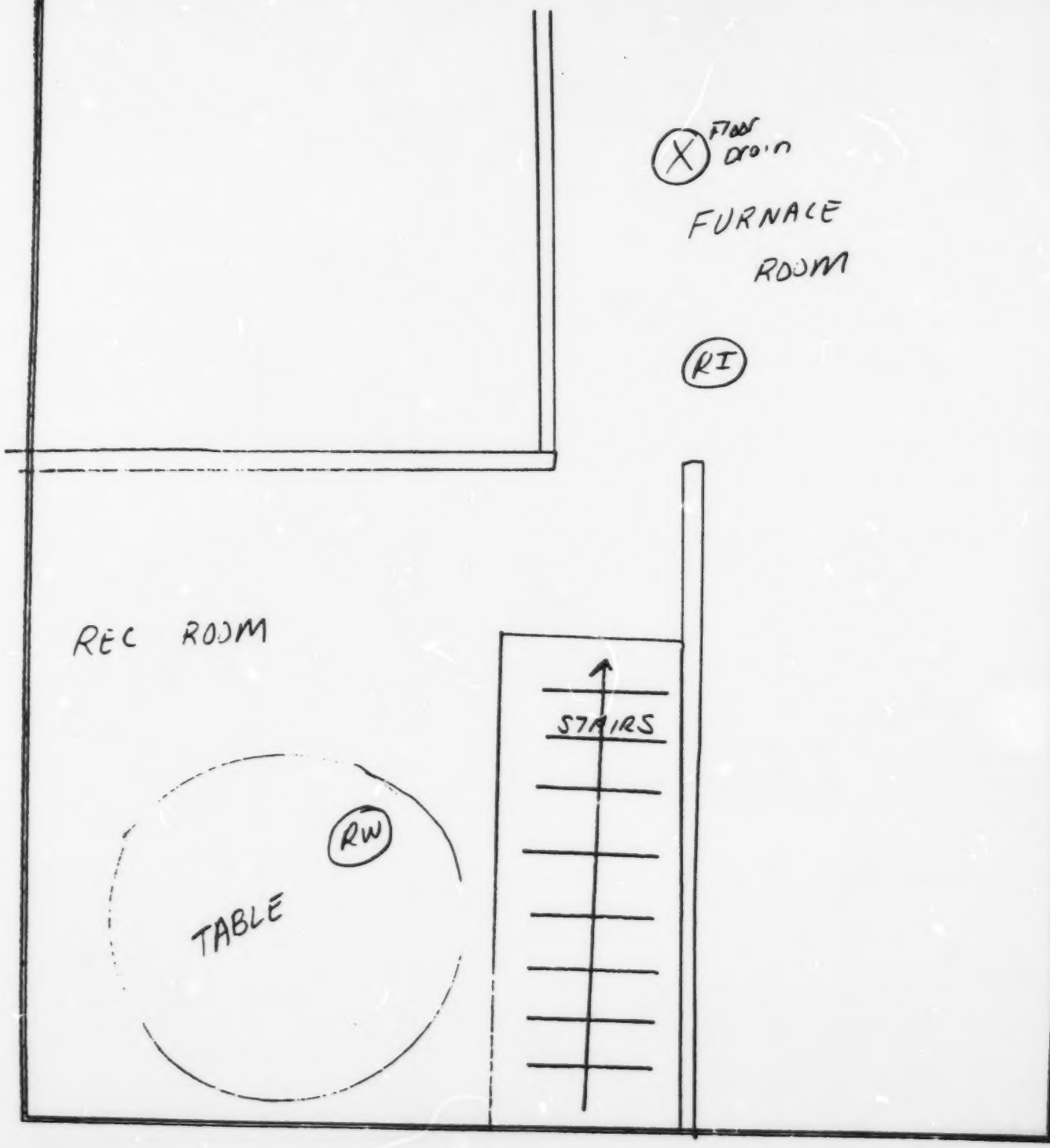
North Indicator



MEASUREMENT SITES	HOUSE I.D. 17

Measurement Site 2:
Location: Basement
Room Volume:
Floor Area:

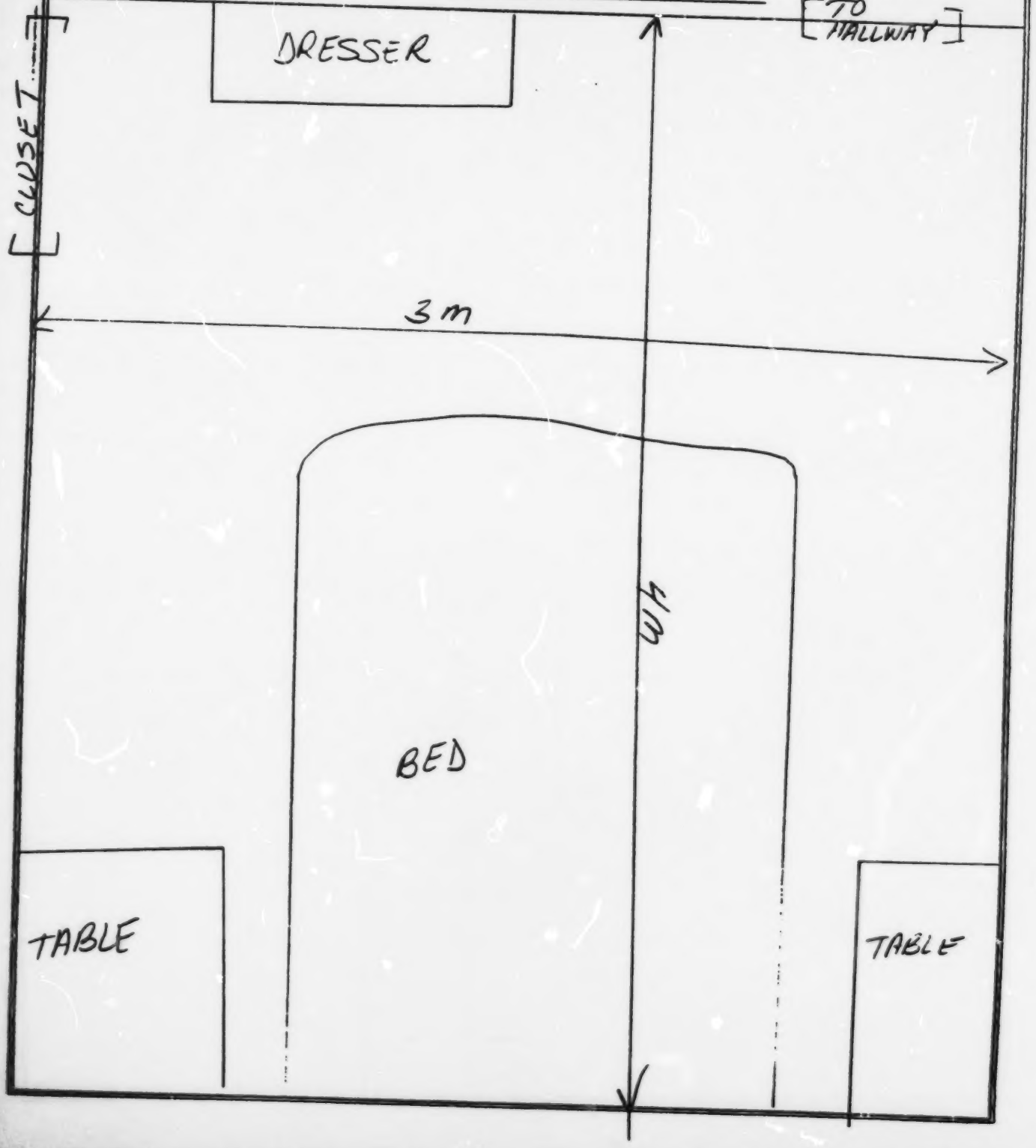
North Indicator



MEASUREMENT SITES	HOUSE I.D. 17

Measurement Site 3:
Location: Bedroom
Room Volume:
Floor Area:

North Indicator [TO HALLWAY]



MEASUREMENT SITES	HOUSE I.D.	17

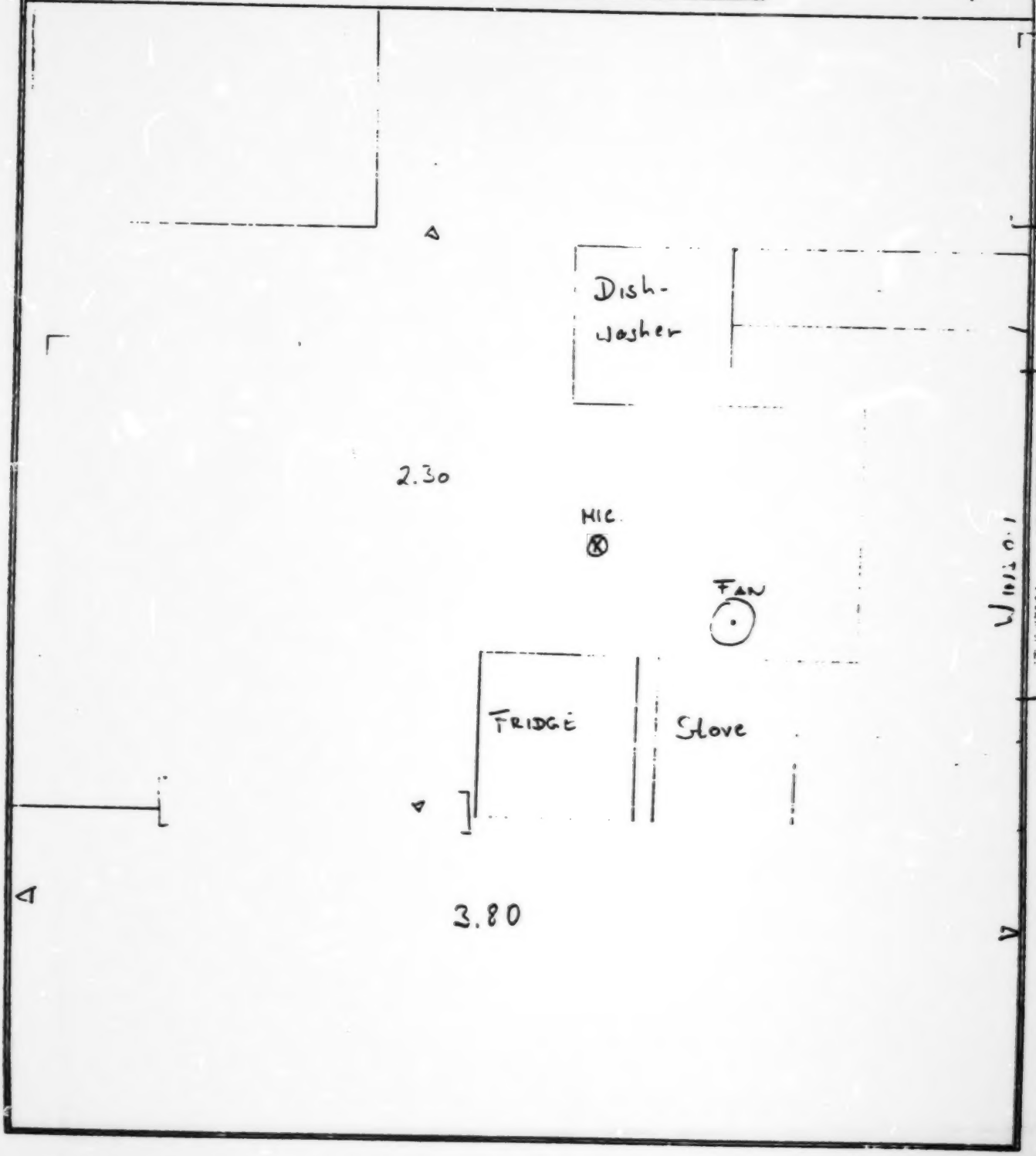
Measurement Site 4:

Location: Kitchen

Room Volume: 21.3 m^3

Floor Area: 8.7 m^2

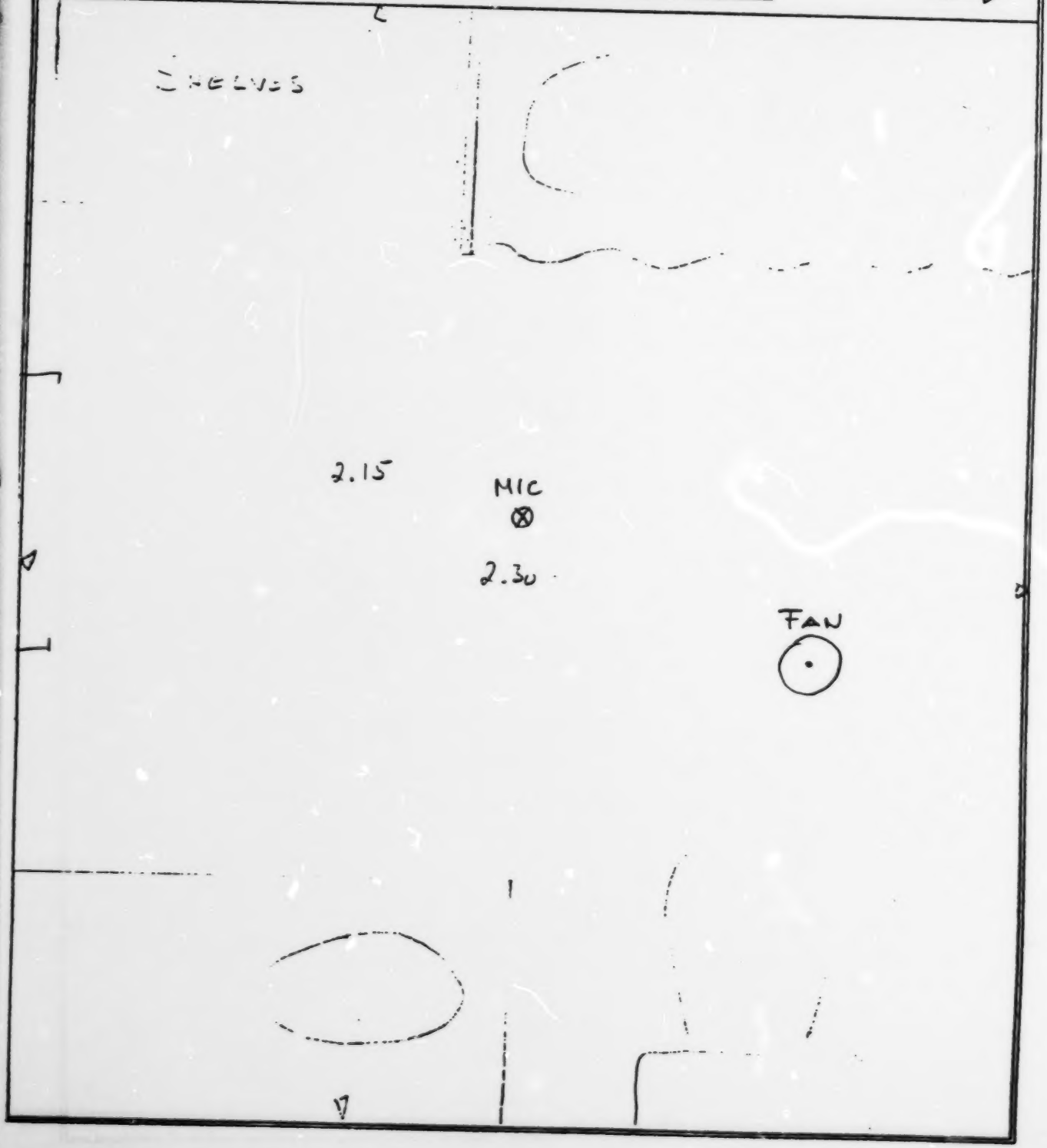
North Indicator



MEASUREMENT SITES	HOUSE I.D. 17

Measurement Site 5:
Location: Bathroom
Room Volume:
Floor Area:

North Indicator →



HOT-2000 Data Input

Canadian Home Builders' Association

R-2000

Introduction:
The information on this form is required for entry into the HOT-2000 computer program, and can be obtained from your building plans and from product specifications. See section 5 in the HOT-2000 User's Guide for supplementary instructions on entering building and mechanical information.

General Instructions:
The data on this form will be checked to ensure that they are consistent and reasonable. Should you change your design in such a way as to affect the energy requirements, you are required to submit a revised HOT-2000 Data Input form for analysis. The R-2000 Home Program standard default values are indicated in input boxes where appropriate.

Builder Details:

Company Name: _____

Address: _____

City: _____ Province/State: _____

Postal/Zip Code: _____ Telephone: ( ) -

Home Details:

Address: ID. 17

City: WINNIPEG Province/State: MAN.

Postal/Zip Code: _____ Telephone: ( ) -

Mailing Address (if applicable) _____

City: _____ Postal/Zip Code: _____

PLEASE ENTER THE APPLICABLE CODE NUMBER, LETTER OR SPECIFIC INFORMATION REQUESTED.

Units of measurement
The units of measurement must be used consistently.
Metric measurements are preferred.
Enter "1" for Imperial measurements
Enter "2" for Metric measurements [2]

Soil conditions
Normal conductivity, dry sand, loam, clay, low water table . . . Enter "1"
High conductivity, moist soil, high water table . . . Enter "2"
Permafrost, soil . . . Enter "3" [2]

Usual or expected space heating temperature settings
Main floor (°C or °F) [21] °C
Bssement (°C or °F) [20] °C
Allowable daily temperature swing (°C or °F) [3.5] °C

Construction mass level
Wood frame construction, 12 mm (0.5 in.) gyproc walls and ceilings, carpet over wood floors "1"
As in 1, except 50 mm (2 in.) gyproc walls and 25 mm (1 in.) gyproc ceilings. "2"
Interior wall finish of 100 mm (4 in.) brick, 12 mm (0.5 in.) gyproc ceilings, carpet over wood floors. "3"
Commercial building construction, heavy interior mass "4"
Enter [1]

HOT-2000 FILE NO. hs 237
Approved run no.
Home location
HOT-2000 location
Date DAY 12 MONTH 08 YR 87

Note:
The following sections allow five entries per component, however the computer will accept up to ten entries per component.
Enter data only where applicable to your building.
INTERIOR measurements of area are required.

Ceiling area
INTERIOR measurements are required. Areas with the same RSI/R value may be totalled as a single item.
When applicable, enter skylight and shaft areas as separate items.

	Area (m^2/ft^2)	RSI/R
1	109	2.6
2		
3		
4		
5		
Total T		

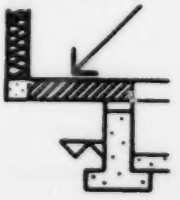
Main wall area
INTERIOR measurements are required. Areas with the same RSI/R value may be totalled as a single item.
Include all floor headers.
Enter window glazing areas in the window glazing component (page 4).

	Area (m^2/ft^2)	RSI/R
1	83	4.8
2		
3		
4		
5		
Total T		

Door area
Do NOT include glazed areas.
Enter door glazing and glazed patio doors in the window glazing component (page 4).

	Area (m^2/ft^2)	RSI/R
1	3.3	0.4
2		
3		
4		
5		
Total T		

Exposed or cantilevered floors
Do NOT include floors over crawl spaces.



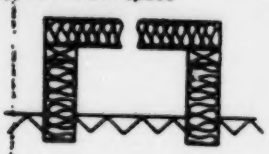
	Area (m^2/ft^2)	RSI/R
1	0	
2		
3		
4		
5		
Total T		

Crawl Space Foundation (where applicable)

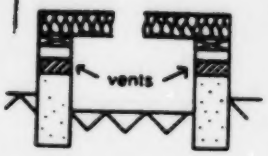
Heating
Enter "1" if Heated (see "Types of Crawl Space" below)
Enter "2" if Unheated or if an open crawl space ☐

If "1" (Heated), enter temperature (°C or °F) 18 °C

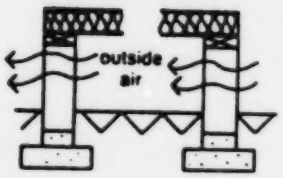
Types of crawl space



1. A closed crawl space is constructed with a tightly sealed wall. The space may be used to store equipment, ducts, pumps, etc. as it is a more controlled environment.



2. A ventilated crawl space is constructed with a wall to protect the space from the weather. This space can be used for storage. It is sealed and vented by openings or wall vents.



3. An open crawl space is completely exposed to exterior winds and temperature.

Enter 1, 2 or 3 ☐

Attachment to other types of foundation
Enter "0" if NOT Attached
Enter "1" if Attached on one side
Enter "2" if Attached on two or more sides ☐

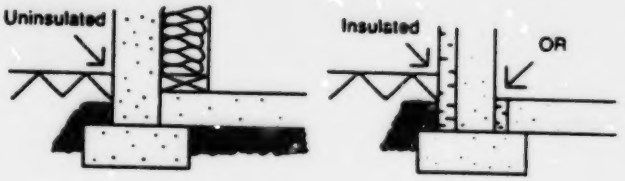
Crawl space insulation placement
Enter "1" if Insulated in the floor joists
Enter "2" if Insulated on the ground ☐

Crawl Space wall
Include above and below grade wall areas.

	Area (m^2/ft^2)	RSI/R
1		
2		
3		
4		
5		
Total		T

Slab on Grade (where applicable)

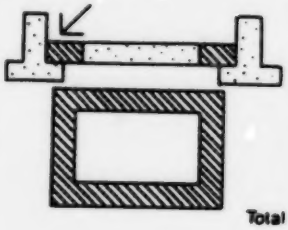
Slab edge insulation
Enter "N" (No) if Uninsulated
Enter "Y" (Yes) if Insulated ☐



Attachment to other types of foundation
Enter "0" if NOT Attached
Enter "1" if Attached on one side
Enter "2" if Attached on two or more sides ☐

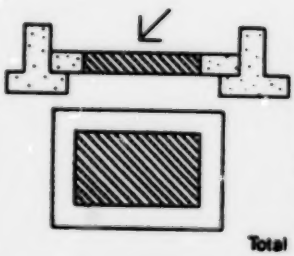
Slab on grade insulation placement
Enter "0" if Uninsulated
Enter "1" if Insulated on top of, or within, the slab
Enter "2" if Insulated under the slab ☐

Slab floor perimeter
(1 m or 3.3 ft. wide)



	Area (m^2/ft^2)	RSI/R
1		
2		
3		
4		
5		
Total		T

Slab floor centre



	Area(m^2/ft^2)	RSI/R
1		
2		
3		
4		
5		
Total		T

Crawl Space
Floor or ground perimeter area
(inside dimensions)
1 m (3.3 ft.) wide

Enter Floor areas and RSI/R values
if Crawl space is UNINSULATED
if Floor areas are INSULATED
in the FLOOR JOISTS.

OR

Enter Ground areas and RSI/R values
if Crawl space is INSULATED
on the GROUND.

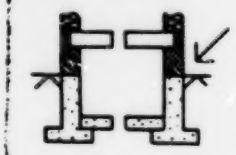
	Area (m^2/ft^2)	RSI/R
1		
2		
3		
4		
5		
Total		T

Crawl Space
Floor or ground centre area

	Area (m^2/ft^2)	RSI/R
1		
2		
3		
4		
5		
Total		T

Basement Walls — Above Grade (where applicable)
For Shallow and Full-Depth Basements

Include doors and ground floor headers. Enter glazing and windows in the WINDOW GLAZING component (page 4).



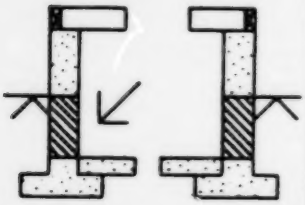
	Area(m^2/ft^2)	RSI/R
1	12.1	0.3
2	12.0	1.4
3		
4		
5		
Total T	25.1	

Shallow Basement (if applicable)
Shallow basements are constructed to a depth just below frost penetration, usually no greater than 1.24 m (4 ft.) below grade.

Attachment to other types of foundation
Enter "0" if NOT Attached
Enter "1" if Attached on one side
Enter "2" if Attached on two or more sides ☐

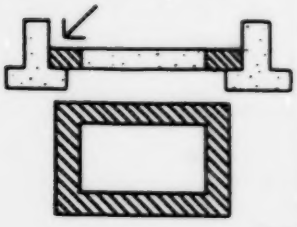
Insulation placement
Enter "0" if Uninsulated
Enter "1" if Insulated inside of, or within, the wall
Enter "2" if Insulated outside of the wall ☐

Below grade walls



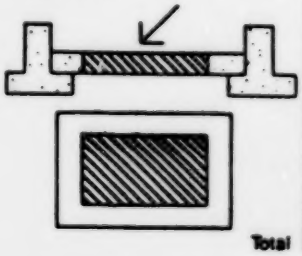
	Area(m^2/ft^2)	RSI/R
1		
2		
3		
4		
5		
Total T		

Floor perimeter 1 m (3.3 ft.)



	Area(m^2/ft^2)	RSI/R
1		
2		
3		
4		
5		
Total T		

Floor centre



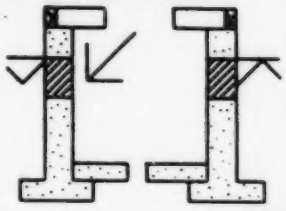
	Area(m^2/ft^2)	RSI/R
1		
2		
3		
4		
5		
Total T		

Full-Depth Basement (where applicable)
Full-depth basements are constructed to a depth greater than 1.24 m (4 ft.) below grade.

Attachment to other types of foundation
Enter "0" if NOT Attached
Enter "1" if Attached on one side
Enter "2" if Attached on two or more sides ☐

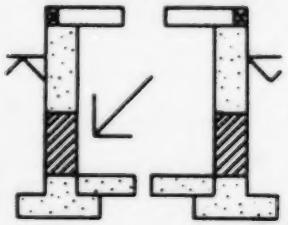
Insulation placement
Enter "0" if Uninsulated
Enter "1" if Insulated inside of, or within, the wall
Enter "2" if Insulated outside of the wall ☐

Upper walls from grade to 0.6 m (2 ft.) below grade.



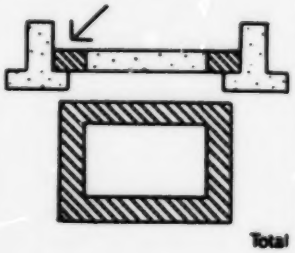
	Area (m^2/ft^2)	RSI/R
1	11.8	0.3
2	11.8	1.4
3		
4		
5		
Total T	23.6	

Lower walls from 0.6 m (2 ft.) below grade to top of floor slab



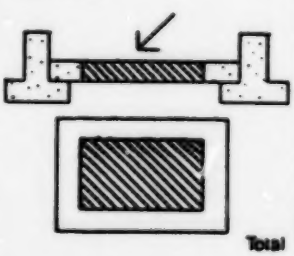
	Area (m^2/ft^2)	RSI/R
1	24.5	0
2	24.5	1.2
3		
4		
5		
Total T	49	

Floor perimeter 1 m (3.3 ft.)



	Area (m^2/ft^2)	RSI/R
1	17.6	0
2	17.6	.25
3		
4		
5		
Total T	35.2	

Floor centre



	Area (m^2/ft^2)	RSI/R
1	25.9	0
2	25.9	.25
3		
4		
5		
Total T	51.8	

Windows, Glazings

This component includes window glazing, patio door glazing and basement window glazing, and where applicable, skylights.

Enter glazing information for the areas with the APPROXIMATE orientation shown below.

EXPLANATION OF ENTRIES

Glazed area:
Area of GLASS only (m^2 or ft^2)
Accuracy to two decimal places is required.

Number of glazings
1. Single glazed
2. Double glazed
3. Triple glazed
4. Quadruple glazed

Enter either the rated RSI/R value of the window or standard default value from the list below

Single glazing	- 0.20 RSI (R 1.14)
Double glazing	- 0.36 RSI (R 2.04)
Triple glazing	- 0.53 RSI (R 3.00)
Quadruple glazing	- 0.70 RSI (R 3.97)

Spacing (only if RSI/R values are not entered)
The distance between glass panes (mm or in.)

Transmission Coefficient
Enter the solar radiation transmission factor, if known, or select standard default value from the list below.

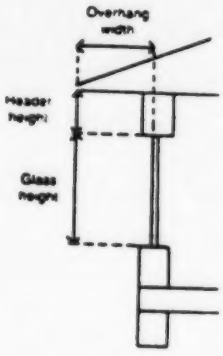
2 mm clear: Single diamond	Single glazed -	1.00
	Double glazed -	0.89
	Triple glazed -	0.80
	Quadruple glazed -	0.73
3 mm clear: Double diamond	Single glazed -	0.94
	Double glazed -	0.82
	Triple glazed -	0.72
	Quadruple glazed -	0.61

Window shading
Accuracy to two decimal places is required.

Glass Height
The height of the glazed portion of the window (m or ft.)

Overhang width
The width of the overhang or awning measured from the face of the glazing (m or ft.)

Header height
The distance between the top of the glass to the underside of the overhang (m or ft.)



Shutter RSI/R:
The rated RSI/R value of functional insulating shutters, if installed

South, Southeast and Southwest Oriented Glazings

Orientation (S, SE, SW)	Glazed Area (m^2/ft^2)	No. of Glazings	RSI/R OR	Spacing (mm/in)	Transmission Coefficient	Window Shading: Height of Glass (m/ft)	Window Shading: Overhang Width (m/ft)	Window Shading: Header Height (m/ft)	Shutter RSI/R
S	6.00	2		10		1.5	.9	-.8	

North, East, West, Northeast and Northwest Oriented Glazings

Orientation (N, E, W, NE, NW)	Glazed Area (m^2/ft^2)	No. of Glazings	RSI/R OR	Spacing (mm/in)	Transmission Coefficient	Shutter RSI/R
N	.18	2		10		
E	.35	2		10		
E	.48	2		50		
N	1.10	2		50		
E	.23	1				
W	1.10	2		50		
N	1.49	2		50		
E	.50	2		50		

Air Infiltration

Total heated house volume (m^3 or ft^3) [ ]

Average natural air infiltration rate in air changes per hour (ach) [0.05]

OR

Is the home sheltered from prevailing winds? (Y/N) [N]

Airtightness: fan depressurization test data in air changes per hour @ 50 pascals pressure differential [2.42]

Equivalent leakage area (cm^2 or $in.^2$) [475]

OR

Is the home sheltered from prevailing winds? (Y/N) [ ]

Construction type (if test DATA are NOT available)
Enter "1" if Loose (pre-1945)
Enter "2" if Average (1945 to 1960)
Enter "3" if Present-day (since 1960)
Enter "4" if Special energy tight [ ]

Mechanical Ventilation

Enter number of rooms:

Kitchen, Dining Room and Living Room	[3]
Bathrooms	[2]
Bedrooms	[3]
Other Habitable Rooms	[/]
Utility Rooms	[/]
Basement (Y/N)	[Y]

Average mechanical ventilation rate in air changes per hour (ach) [0.35*]
(*or calculated R-2000 minimum ventilation rate if greater than 0.35)

Enter "1" if BALANCED ventilation air flow
(a balanced system has equal and simultaneous supply and exhaust air flows)

Enter "2" if UNBALANCED ventilation air flow
(an unbalanced system supplies or exhausts air only, or supplies and exhausts air in unequal amounts) [2]

Primary Ventilation System
Enter "1" if mechanical ventilator and/or fans
Enter "2" if heat recovery ventilator (HRV)
Enter "3" if heat pump ventilator (air-to-air)
Enter "4" if heat pump ventilator (air-to-water) [1]

Ventilation System

Manufacturer: unknown

Model Name or Number: —

For mechanical ventilator or fans, enter rated power (watts) [as↓ 30]

For Heat Recovery Ventilator enter:

Power required (watts) @ 0 °C (32 °F) [ ]

Power required (watts) @ – 25 °C (– 13 °F) [ ]

If pre-heater, enter total power (watts) [ ]

Heat recovery efficiency (%) @ 0 °C (32 °F) [ ]

Heat recovery efficiency (%) @ – 25 °C (– 13 °F) [ ]

Low temperature ventilation reduction (%) [ ]

For Heat Pump Ventilators enter:

Annual space heating energy credit in MJ (if applicable) [ ]

Annual DHW energy credit in MJ (if applicable) [ ]

Daily Base Electrical Load (includes 2 kWh/day for exterior use)

Enter "9" kWh if low electrical consumption
Enter "16" kWh if average electrical consumption
Enter "25" kWh if high electrical consumption [16] kWh/da

Daily Domestic Hot Water Use

Enter "186" litres/day (40 gallons/day) if low use
Enter "236" litres/day (52 gallons/day) if average use
Enter "300" litres/day (66 gallons/day) if high use [236] litres/da

Daily Internal Occupancy Gains

Allow 1.6 kWh for each adult per 24-hour period
Allow 0.8 kWh for each child per 24-hour period
Enter total: 3.7 [~~20~~] kWh/da

Primary Space Heating Fuel

Select your primary space heating fuel
Note: A heat pump (except a combined gas-fired furnace/heat pump) is always considered as secondary equipment. If a fireplace or wood stove is the only space heating equipment, enter 4.

Enter "1" if Electricity
Enter "2" if Natural Gas
Enter "3" if Oil
Enter "4" if Propane
Enter "5" if Wood/Solid Fuel [2]

Primary Space Heating Equipment

Select one code number from the following equipment types which corresponds to your primary space heating equipment: [1]

Electric Space Heating Equipment
1 — Baseboard/hydronic/plenum (duct) heater (100%)
2 — Forced-air furnace (100%)
3 — Radiant heating (100%)

Oil Space Heating Equipment
1 — Conventional furnace/boiler (60%)
2 — Conventional furnace/boiler with flue vent damper (64%)
3 — Conventional furnace/boiler with flame retention head (70%)
4 — Mid-efficiency furnace/boiler (no dilution air) (82%)
5 — Condensing furnace/boiler (no chimney) (90%)

Natural Gas/Propane Space Heating Equipment
1 — Conventional furnace/boiler with pilot (60%)
2 — Conventional furnace/boiler with spark ignition (63%)
3 — Conventional furnace/boiler with spark ignition and vent damper (69%)
4 — Induced draft fan furnace/boiler (80%)
5 — Condensing and pulse furnace/boiler (90%)
6 — Combined gas-fired furnace/heat pump (enter heat pump data)

Wood/Solid Fuel Space Heating Equipment
1 — Airtight wood stove (55%)
2 — Airtight wood stove with catalytic converter (65%)
3 — Wood/solid fuel furnace (45%)

Primary Space Heating Equipment Efficiency

Select one of the following efficiency ratings:
1. Annual Fuel Utilization Efficiency (AFUE)
2. Seasonal Gas Utilization Efficiency (SGUE)
3. Manufacturer's steady-state efficiency rating
4. Seasonal Efficiency (Default Value from above table) [3]

If 1, 2 or 3, Enter efficiency (%) [75]

Primary Space Heating Equipment Characteristics

Enter Manufacturer: General Steel Wares

Enter Model Name or Number: EG-112 H-1

Enter rated output heating capacity (kW or Btu/h) [24.6]

Heat Pumps

Enter Manufacturer: _____

Enter Model Name or Number: _____

Heat Pump Source Type

Enter "0" if Air (outside)
Enter "1" if Water (well or lake) source
Enter "2" if Ground source [ ]

Heat Pump Temperature Cut-off Control

Enter "1" if BALANCE POINT temperature cut-off (heat pump shuts off when unable to meet entire heating load)
Enter "2" if RESTRICTED temperature cut-off (heat pump shuts off below a defined temperature)
Enter "3" if UNRESTRICTED operation [ ]

If "2" (Restricted), Enter cut-off temperature (°C or °F) [ ]

Rated heating capacity at 8.3 °C (47 °F) in kW (Btu/h) [ ]

Heating Coefficient of Performance at 8.3 °C (47 °F) [ ]

If combined gas-fired/furnace heat pump also enter:

Gas Heating Coefficient of Performance at 8.3°C (47°F) [ ]

Gas rated heating capacity at 8.3°C (47°F) in kW (Btu/h) [ ]

Electrical power input in kW during gas operation at 8.3°C (47°F) [ ]

Domestic Hot Water Heating Equipment

Select one code number which describes your primary and any secondary domestic water heating equipment:

Primary Equipment [7]

Secondary Equipment [ ]

0 — None installed
1 — Electric tank (93%)
2 — Electric domestic water heat pump (100%)
3 — Tankless coil, electric (100%)
4 — Instantaneous (point-of-use) electric water heaters (100%)
5 — Conventional oil-fired tank (45%)
6 — Tankless coil, oil-fired (55%)
7 — Conventional gas/propane tank (45%)
8 — Tankless coil, gas/propane (50%)
9 — Instantaneous (point-of-use) gas water heaters (50%)
10 — Induced draft fan: gas/propane (58%)
11 — Direct vent (sealed): gas/propane (58%)
12 — Fireplace or wood stove water coil (secondary only)
13 — Solar collector system

Primary Domestic Water Heating Characteristics:

Enter Manufacturer: Rheem

Enter Model Name or Number: RG40-36M

Enter tank capacity (if applicable) in litres (gallons) [112]

Enter seasonal efficiency (%) (if known) [45]

If solar collector system (13), enter annual CSIA rating (MJ/yr) [ ]

Secondary Domestic Water Heating Characteristics:

Enter Manufacturer: _____

Enter Model Name or Number _____

Enter tank capacity (if applicable) in litres (gallons) [ ]

Enter seasonal efficiency (%) (if known) [ ]

If solar collector system (13), enter annual CSIA rating (MJ/yr) [ ]

NOTES:

General House Description

Canadian Home Builders Association

R-2000

Number of Storeys (maximum of 2 entries)

1. One storey
2. One-and-a-half
3. Two storeys
4. Two-and-a-half
5. Three storeys
6. Multi-storey
7. Split-level
8. Split-entry

[1]
[ ]

House Type

1. Single Detached
2. Link Single
3. Double/Semi-detached
4. Duplex
5. Triplex
6. Individual Unit (apartment)

[1]

South Side Sun Obstruction

1. None
2. 1% to 25%
3. 26% to 50%
4. 51% to 75%
5. 76% to 100%

[2]

Nature of Obstruction

1. Buildings
2. Trees
3. Buildings and trees
4. Natural terrain

[2]

Foundation Materials (maximum of 4 entries)

[2]
[ ]
[ ]
[ ]

1. Not applicable
2. Poured concrete
3. Concrete block
4. Preserved wood walls and floor
5. Preserved wood walls/concrete floor
6. Steel

Predominant Wall Construction

1. Single stud wall
2. Double stud wall
3. Strapped wall
4. Truss-type wall
5. Curtain-type wall
6. Stressed-skin wall
7. Solid masonry/brick
8. Solid log

[1]

Type of Air Barrier

unable to determine

1. Not applicable
2. Polyethylene
3. Aluminum foil
4. Continuous wood sheathing
5. Continuous drywall
6. Sprayed-in-place barrier
7. Polyolefin materials (e.g. Tyvek)

[ ]

Location of Air Barrier

1. Exterior wall surface
2. Interior wall surface
3. Partly in wall cavity

[ ]

Are the air and vapour barriers combined? (Y/N)

[ ]

Garage

1. Not applicable
2. Not attached
3. Attached to a heated space
4. Attached to an unheated space
5. In basement

[1]

Garage Heating

1. Not heated
2. Heated by house heating system
3. Heated by a separate heating system

[ ]

Other Enclosures

1. Not applicable
2. Not attached to house
3. Attached to a heated space
4. Attached to an unheated space

[1]

Solid Fuel-Burning Equipment

Type
(maximum of 2 entries)

1. Not applicable
2. Fireplace with glass doors
3. Fireplace with insert
4. Wood stove
5. Wood/coal furnace

Entry 1 [1]
Entry 2 [ ]

Combustion Air Supply:
(maximum of 2 entries)

1. Directly from outside
2. From attached heated space
3. From attached unheated space
4. No combustion air supply

Entry 1 [ ]
Entry 2 [ ]

SPECIMEN TEST REPORT

NAME OF CO G.K. YUILL AND ASSOCIATES LTD.

ADDRESS OF CO 1441 PEMBINA HWY., WPG., MAN. R3T 2C4

NAME OF TESTER D. SOLMUNDSON / D. YUILL

ADDRESS OF BUILDING HOUSE I.D. #17

DATE OF TEST 24/07/07 DATE OF REPORT _____

TIME: 1600 LOCAL

WEATHER DATA

OUTDOOR TEMPERATURE 26 °C

WIND SPEED 15 km/h WIND DIRECTION S

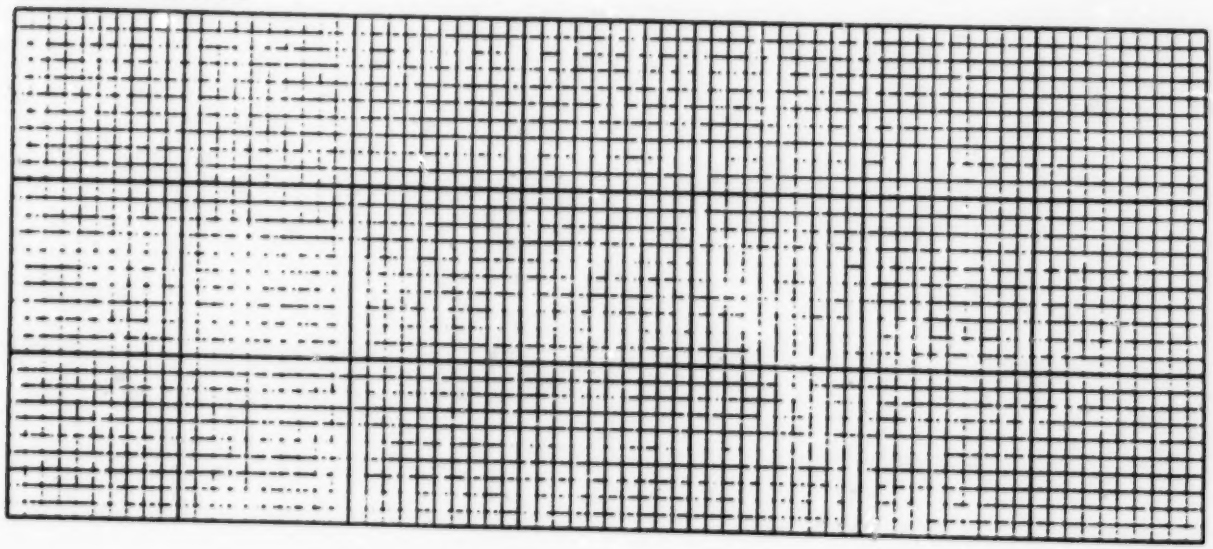
WIND VARIABILITY VARIABLE

ENVELOPE

☐ BUILDING ENVELOPE ☐ OTHER _____

AREA _____ m² INTERIOR VOLUME _____ m³

BUILDING SKETCHES



(2) MEASURED DATA

$Q_m = 14.7 (\Delta P)^{.4975}$ Pa

Δ P m (Pa)	Fan Speed (r/min) or Δ P nozzle (Pa)	Q_m (L/s)	t (°C)
50	610	357.29	23 °C
39	450	307.11	
30	300	251.01	
20	175	191.97	
15	115	155.78	
25	245	226.45	
35	360	274.84	
45	560	342.41	

(4) CORRECTED DATA

Δ P (Pa)	Q_r (L/s)
15	155.78
20	191.97
25	226.95
30	251.01
35	274.84
39	307.11
45	342.41
50	357.29

(6) RELATIVE ERROR

$\left| \frac{Q_{ri} - \hat{Q}_{ri}}{Q_{ri}} \right|$

0.0054
0.0037
0.0160
0.0097
0.0264
0.0098
0.0191
0.0114

(1) $\Delta P_{o,i}$ 0.0

(3) $\Delta P_{o,f}$ 0.0

$\hat{Q}_{ri} = C_r \Delta P^n$

$\Delta P = \Delta P_m - \frac{(\Delta P_{o,i} + \Delta P_{o,f})}{2}$

CALCULATED DATA

(5a)
- C_r 23.8878 L/(s Pa^n)
- n 0.6944
- r 0.9976

(7)
- ELA 0.0475 m^2
- NLA _ _ cm^2/m^2

(5b) RELATIVE STANDARD ERROR 0.0260

AIR EXCHANGE MEASUREMENT USING
THE TRACER GAS TECHNIQUE

House Identification Number: 17

Date of Test: July 27, 1987 Time: 2:00 PM

WEATHER DATA

Outdoor Temperature: 28 °C

Wind Speed: 9 km/hr Wind Direction: S

Barometric Pressure: 101.27 KPa.

HOUSE IDENTIFICATION NUMBER: 17

TIME (min)	CONCENTRATION (ppb)
0	-
10	55.75
20	-
30	54.93
40	54.61
50	53.87
60	52.31

Correlation Coefficient: -.93733

Air Exchange Rate (Ach/hr): 0.0704

MIX CHECK

Location	Time	Concentration
Basement	25	56.21
Bedroom	45	53.60

$$C = e^{(at + b)}$$

a = -.0011727025

b = 4.038745 77

Where :

C = tracer gas concentration

t = sample time

a = regression coefficient

b = regression coefficient

APPENDIX C

DETAILED TRACER GAS TESTING PROCEDURES

1.0 INTRODUCTION

An outline of the procedures for gas sampling with evacuated glass tubes is provided in DBR Paper No. 1165 (Division of Building Research of the National Research Council). However, it does not discuss in detail the finer techniques which are generally practiced when measuring the air exchange rate of buildings using the tracer gas method. This paper discusses in detail these finer techniques which include preparation of doses, injection of doses into buildings, and collection of samples. The apparatus which is referred to in this paper consists of a Matheson lecture bottle and regulator assembly, standard syringes and 20 ml draw septum-stoppered vacutainers which are ordinarily used for blood sampling in hospitals.

2.0 DOSE PREPARATION

It is important that tracer gas doses are not prepared at the locations where the tracer gas tests are to take place. This practice will avoid the risk of leakage of SF_6 from the lecture bottle into the area being tested. Prepare the appropriate doses for the houses that are to be tested in the office and bring only the prepared doses into the field where the testing is to take place. The following is a list of the procedures to be followed when preparing doses.

1. Check the dose syringe for leaks. This is done by submersing a syringe with the plunger withdrawn and a small rubber stopper on the needle in water. Pressurize the syringe by pushing in the plunger and watch for air bubbles. If no leaks are present, proceed to the next step.

2. Purge the regulator and septum chamber assembly on the lecture bottle by following the steps below.

   - locate the apparatus near an exhaust fan or outdoors
   - with the needle valve closed, adjust the regulator to 10 psi
   - insert syringe into the septum
   - open the valve thus allowing the pressure to fill the dose syringe and then expel the gas (20 to 30 cc should purge the system completely)

3. Fill the dose syringe to the desired volume (see the appendix section for calculating the desired volume). This is accomplished by inserting the syringe needle into the septum and allowing the gas pressure to drive the plunger to a point beyond the desired volume. Withdraw the needle from the septum and press the plunger to the desired volume mark. Allow the pressure in the syringe to stabilize for 3 seconds and cap the needle with a rubber stopper.

4. Close the needle valve and turn off the pressure regulator.

IMPORTANT NOTE: Dose syringes should not be used for sampling. Clearly label syringes as either "Dose Syringe" or "Sampling Syringe".

3.0 ON-SITE PREPARATION AND INJECTION OF SF_6

1. Immediately upon entering the test site, record the time, date, and weather conditions in a log book. Weather conditions can be obtained by calling the Weather Office of Environment Canada (Winnipeg Airport) at the following numbers.

Winnipeg Weather	983-2070
Winnipeg Weather (recorded)	983-2050
Winnipeg Weather (Officer in charge)	983-4847

2. Open, then close and lock all doors and windows which are normally closed in the building and turn off all exhaust fans. This is to ensure that all windows and doors are shut tightly. Note whether or not the pilot light in the furnace is on or off.

3. Drill a small hole (1/16") in the return air duct upstream from the circulation fan. The thermostat should be turned down with the fan still running.

4. Remove the rubber stopper from the needle on the dose syringe and inject the tracer gas into the duct through the hole just drilled.

5. Allow 30 minutes for the tracer gas to mix throughout the building. In this time, prepare 7 vacutainers plus a few back ups for sampling. Preparation involves reinforcing the septum-stopper on the vacutainer with a strong tape (white fabric tape is preferable for labeling purposes). This reinforcing ensures that the septum-stopper does not pop out when the container is pressurized with the gas sample.

NOTE: In houses without a central warm-air heating system, floor fans should be used to circulate the tracer gas. Samples should be taken at a central location.

4.0 COLLECTION OF GAS SAMPLES

To obtain good results from a tracer gas test, it is important that the times of sampling are recorded accurately. It is therefore recommended that a stopwatch be used. The following is a detailed description of the sampling procedure with emphasis on the technique of withdrawing samples and pressurizing the vacutainers with the sample gas.

1. Prior to sampling, test the sampling syringe on site for leaks, then carefully and gently dry the syringe needle. Do not draw samples with a leaky syringe! Use of a leaky syringe can lead to diluted gas samples and erroneous measurement results.

2. Obtain the first sample from the return-air stream through the hole drilled in the return air duct. Start the stopwatch at precisely the time that the plunger on the syringe is withdrawn. Use the following technique for withdrawing each sample:

   a) With the needle of the syringe in the return-air stream, flush the syringe by fully withdrawing and compressing the plunger to its original position at least once. This should be done within the 30-second time interval prior to taking the sample.

   b) At the time of sampling, obtain the sample from the return air stream by steadily withdrawing the plunger to approximately the 60 cc mark on the syringe. Leave the needle in the return-air stream for approximately 3 seconds immediately following this procedure, thus allowing for the pressure in the syringe to reach equilibrium. Push the plunger on the syringe to the 50 cc mark.

   c) Immediately insert the needle into the vacutainer through the center of the taped-in-place septum/stopper.

d) Check that the plunger is freely drawn into a position between the 30 and 40 cc marks by the vacuum in the sample tube. If this is not observed, the vacutainer is faulty. Replace the vacutainer and repeat steps (a) to (d), recording the new time at which the replacement sample is taken.

e) After allowing the vacutainer to reach equilibrium with the syringe, pressurize the vacutainer by completely depressing the sampling syringe. Hold the syringe in this position for at least 3 seconds before withdrawing the needle.

f) Clearly label the vacutainer with the appropriate information (time, location, comments). The time should be recorded relative to the test starting time. The first sample should be labeled, t=0. The vacutainer label must unambiguously distinguish the test of which its sample is a part. This can be done satisfactorily by including the street address of the house, the date, and the time of the test start on the label.

3. Repeat step 2 for t = 10, 20, 30, 40, 50, and 60 minutes. Use the stop watch to obtain samples precisely at these times.

4. When the test is complete, cover the hole with a piece of duct tape and return any thermostat settings, etc. to their original settings. Check to confirm that the pilot light, if lit at the start of the test, is still lit. Re-light according to furnace or water heater manufacturer's instructions if it has gone out during the test.

APPENDIX C.1

CALCULATION OF DESIRED VOLUME OF TRACER GAS

C.1 CALCULATION OF DESIRED VOLUME OF TRACER GAS

To conduct the tracer gas test, it is recommended that the initial concentration in the building be approximately 50 ppb. Therefore, it is necessary to obtain a reasonably accurate estimate of the volume of the building. The following equation should be used for determining the volume of tracer gas for each application:

$$V_t = V_b * 50 * 10^{-9} * 28317$$

where: V_t = volume of tracer gas in cm^3

V_b = volume of building in ft^3

$50 * 10^{-9}$ = desired initial concentration of tracer gas

28317 = conversion factor (1 ft^3 = 28317 cm^3)

APPENDIX C.2

SHIPPING OF SAMPLES FOR ANALYSIS

C.2 SHIPPING OF SAMPLES FOR ANALYSIS

The collected gas samples will be shipped to IRC where they will be analyzed with an electron capture gas chromatograph. The sample tubes are glass and should be packed appropriately.

Shipping Address:

Institute for Research and Construction
National Research Council, Canada
Montreal Road, M-24
Ottawa, Ontario
K1A 0R6

Attention: Mr. R. G. Evans

IRC will also require a copy of the detailed description of the building, weather conditions during the test, and blower door test data if and when available.

APPENDIX C.3

SF_6 LECTURE BOTTLE APPARATUS

C.3 SF_6 LECTURE BOTTLE APPARATUS

The items required for the SF_6 lecture bottle apparatus are the following:

1 - Lecture Bottle, Sulfur Hexaflouride, C.P.
(Matheson Products Canada)

1 - Model 3320 Lecture Bottle Regulator which comes complete with a mating hose connection.
(Matheson Products Canada)

1 - 3/16" I.D. x 5/16" O.D. x 1/16" wall, clear P.V.C. tubing.

1 - Package of rubber septums (100/pkg)
(Fisher Scientific CAT. NO. 02-683-54)

Assembly procedures for attaching the regulator to the lecture bottle are listed in the manual which is provided with the Matheson Gas Regulator. Attach a rubber septum to the hose connector on the regulator according to the following procedure:

1. Cut approximately 3/4" of PVC tubing and place it over the hose connector on the regulator. The end of the tubing should be flush with the end of the connector.

2. Place a rubber septum over the PVC tubing on the hose connector.

3. Secure the rubber septum and the PVC tubing to the hose connector by tightly wrapping a fine wire around the septum.

Prior to preparing doses for tracer gas tests, it is recommended that the regulator be set at approximately 10 Pa. Turning the pressure-adjusting screw on the regulator counter clockwise will lower the outlet pressure.

APPENDIX C.4

EVALUATION OF EVACUATED GLASS TUBES FOR SAMPLING OF SF_6 AIR MIXTURE FOR AIR EXCHANGE MEASUREMENT

DBR Paper No. 1165
Division of Building Research

National Research Council Canada
Conseil national de recherches Canada

EVALUATION OF EVACUATED GLASS TUBES FOR SAMPLING OF SF_6/AIR MIXTURE FOR AIR EXCHANGE MEASUREMENT

by G.T. Tamura and R.G. Evans

Reprinted from
ASHRAE Journal, October 1983
p. 40 - 43

DBR Paper No. 1165
Division of Building Research

Price $1.00

OTTAWA

NRCC 23055

Canada

ABSTRACT

Grab sampling of tracer gas/air mixture is a convenient method for conducting a survey of air infiltration rates in homes. Gas samples may be collected with a hypodermic needle and stored in Vacutainers. This technique is particularly suited when sulphur hexafluoride (SF_6) is used as a tracer gas, as only a small quantity of gas sample is required to measure its concentration with an ion capture detector/chromatograph.

Because an extended delay is probable between collection and analysis of gas samples, storage stability tests of SF_6/air mixture in 20 mL Vacutainers were conducted. Samples can be stored for at least 21 days without significant changes in their concentrations.

The gas sampling and analysis procedures are described in detail.

RÉSUMÉ

Le prélèvement au hasard d'échantillons de mélange gaz traçant/air est une méthode pratique pour étudier les taux d'infiltration de l'air dans les habitations. Les échantillons de gaz peuvent être prélevés avec une seringue hypodermique et conservés dans des tubes Vacutainer. Cette technique convient particulièrement bien lorsqu'on utilise l'hexafluorure de soufre (SF_6) comme gaz traçant car la mesure de la concentration de ce gaz avec un chromatographe à détection par capture d'ions ne nécessite qu'une petite quantité de gaz.

En raison des délais probables entre le prélèvement et l'analyse des échantillons de gaz, des essais de stabilité du mélange SF_6/air conservé dans des tubes Vacutainer de 20 ml ont été effectués. Les échantillons peuvent être conservés pendant au moins 21 jours sans que l'on note des variations importantes de concentration.

Les méthodes de prélèvement et d'analyse des échantillons de gaz sont décrites en détail.

Evaluation Of Evacuated Glass Tubes For Sampling Of SF_6/Air Mixture For Air Exchange Measurement

G.T. TAMURA
Member ASHRAE

R.G. EVANS

HEAT loss caused by air that leaks in and out through cracks in the house envelope can be a significant component of the total heat loss. Extensive measurements of air exchange rate, therefore, are being conducted to assess and develop means of reducing this heat loss and to study the influence of air exchange rate and house air tightness on indoor air quality.

Air exchange rate in houses is usually measured using the tracer gas technique. It involves releasing a small quantity of tracer gas inside the house to mix with the room air, and measuring its rate of decay which is related to the rate of air infiltration by:

$$I = \frac{1n(C_i/C_o)}{t_o - t_i} \quad (1)$$

where:

I = air exchange rate, air change per unit time
C_i = concentration of tracer gas at time, t_i
C_o = concentration of tracer gas at time, t_o

At least two readings of tracer gas concentration are required during the decay period, but usually several readings are taken. The air infiltration rate is determined from the slope of the 1n C versus time curve using the least square method.

G.T. Tamura and R.G. Evans are with the Energy and Services Section, Division of Building Research, National Research Council Canada in Ottawa.

The tracer gas concentration is measured with an instrument either in the house or in the laboratory. In the latter case, gas samples are collected at the site and transported to the laboratory for analysis. This method is suited for a survey of houses because gas samples can be collected following a simple procedure, also, the gas analysis instrument and its associated equipment need not be transported and set up for operation at the test site.

One method of collecting gas samples investigated by Harrje, Gadsby and Linteris[1] is the use of a 500 mL flexible polyethylene bottle with a 6 mm hole through the cap, covered with a 2 mm thick natural rubber gasket. The gasket seals the bottle and acts as a septum into which a hypodermic syringe can be inserted to draw a collected gas sample for analysis. A sample is collected by removing the gasket and hand squeezing the bottle ten times to ensure that the air in the bottle represents the sampled air.

Another method of collecting gas samples used by Grot[2] is the use of a 10L, five layer air sample bag and a hand pump or a small battery-powered pump. The hand pump requires about 50 strokes to fill the bag, and the battery-powered pump, about five minutes of operation.

For collecting mine atmospheric samples, Freedman et al.[3,4] investigated the use of 10 and 30 mL septum-stoppered evacuated glass tubes ordinarily used for routine blood sampling in hospitals. They are light and compact and

Table 1 Storage Stability Test Of SF_6 In Evacuated Glass Tubes
Test No.1

Time (min)	SF_6 Direct Sampling, ppb	SF_6 Concentration in Tubes, ppb Storage Period, Days						Mean	Standard Deviation
		0	1	3	5	7	14		
0	16.6	16.1	16.5	16.5	16.3	16.6	16.5	16.3	0.15
0		16.1	16.3	16.3	16.2	16.3	16.4		
15	14.8	14.3	14.5	14.4	14.4	14.5	14.6	14.4	0.10
15		14.3	14.4	14.4	14.3	14.4	14.4		
30	13.0	12.7	12.8	12.8	12.7	12.8	12.8	12.7	0.10
30		12.5	12.7	12.7	—	12.7	12.8		
45	11.5	11.1	11.4	11.3	11.3	11.4	11.4	11.3	0.11
45		11.0	11.2	11.3	11.2	11.3	11.3		
60	10.1	9.8	9.9	10.0	9.9	10.0	10.0	9.9	0.08
60		9.8	9.8	9.9	—	9.9	9.9		
		Calculated Air Change/Hr Using Decay Data Above							
	0.50	0.50	0.50	0.51	0.50	0.50	0.49	0.50	0.006
		0.50	0.51	0.50	0.49	0.50	0.50		

Grab sampling of a tracer gas/air mixture in conjunction with the tracer gas decay technique is a convenient method for conducting a survey of air infiltration rates in homes. Such a method, using sulphur hexafluoride (SF_6) as the tracer gas and storing the concentration in evacuated glass tubes, is examined.

reduce the weight and bulk of equipment that is carried underground. The storage stability of the air/gas mixtures of CO_2, CH_4, O_2, N_2, and hydrocarbons during storage in the evacuated glass tubes was reported.

The evacuated glass tubes are suited for taking grab samples when sulphur hexafluoride (SF_6) is used as a tracer gas, because only a small quantity of air/gas mixture is required to measure its concentration with an ion capture detector/chromatograph. Because the glass tube has been evacuated, a gas sample can be collected in less than a minute. The evacuated glass tubes are light and compact, can be transported easily and cheaply, and because of low cost, can be discarded after use.

A series of tests was conducted to develop and verify a procedure for grab sampling with evacuated glass tubes as applied to air exchange measurement, and also to determine the storage stability of the gas samples. Additional tests were conducted to assess the effect of possible exposure of the stored gas samples to extreme temperature during transport and the hazard caused by accidental glass tube breakages.

Test procedure

The sampling tubes used for the tests were 20 mL evacuated glass tubes, silicone coated and stopped by 6.35 mm thick butyl rubber septa. Ten randomly selected tubes tested for vacuum gave an average pressure of 0.036 atmosphere (3.65 kPa). The SF_6 gas samples were taken from the indoor air with a 60 mL plastic syringe and transferred to the evacuated glass tubes by inserting the needle of the syringe into the septum (Figure 1). Twice the tube volume of gas was injected by pushing the plunger of the syringe, raising the tube pressure to about one atmosphere (101.3 kPa) above ambient pressure.

The instrument used for measuring the SF_6 concentration was the ion capture detector/chromatograph, sensitive to SF_6 in the few-parts-per-billion range. A syringe needle was attached to the inlet port of the instrument to permit transfer of the sample gas under pressure in the glass tube to the sampling loop of the instrument (sampling pump was removed).

The instrument has a 2 mL sampling loop with a 6 port sampling valve, a 6.35 mm O.D. 380 mm column of 100/120 mesh aluminum oxide and an ion capture detector, both of which are continuously flushed with carrier gas of nitrogen. The detector has a radiation source of Ni 63 (10 mc), which ionizes the carrier gas to produce a standing current. When a measurement is required, the sample gas trapped in the sampling loop is directed to the column, where it is absorbed. The oxygen is eluted first, followed by SF_6. These gases capture the ions produced by the radiation source, causing the standing current to decrease in proportion to the gas concentration. The concentration of SF_6 can be determined either by the SF_6 peak or the area under the peak; in these tests the former method was used.

To collect samples of SF_6 for air exchange measurement, tests were conducted in a two-story house with the furnace fan of the central warm air heating system operating continuously. A sufficient quantity (about 20 mL) of SF_6 was injected with a syringe into the return air duct to reach a tracer gas/air concentration of 25 ppb. As a check, nitrous oxide, another commonly used tracer gas, was also injected at the same time into the return air duct. The SF_6/air mixture was sampled 30 minutes after injection (when the tracer gas concentration had started to decline), and thereafter at 15-minute intervals during the next hour.

The set-up for gas sampling is shown in Figure 3. Gas samples were pumped through two plastic tubes from the return air duct; one to the SF_6 detector/chromatograph, and the other to an N_2O non-dispersive infrared gas analyzer. Two additional sample lines were installed to permit six people, at the same time, to draw two samples from the lines by

Table 2 Storage Stability Test Of SF_6 In Evacuated Glass Tubes Test No. 2

Time (min)	SF_6 Direct Sampling, ppb	SF_6 Concentration In Tubes, ppb Storage Period, Days						Mean	Standard Deviation
		0	1	3	5	7	21		
0	20 2	19.3	19.6	19.7	19.6	19.6	19.7	19.5	0.15
0		19.2	19.5	19.5	19.6	19.6	19.5		
15	18 8	17.9	17.9	18 0	18 0	18 1	18 1	18 0	0 09
15		17 8	17.9	17.9	18 0	17.9	18 0		
30	17 3	16 3	16 4	16 6	16 5	16 4	16 6	16 4	0 16
30		16 1	16.3	16.5	16.4	16 2	16 5		
45	15 8	15 1	15 2	15 4	15 3	15 2	15 4	15 2	0 11
45		15 1	15 1	15 3	15 3	15 2	15 3		
60	14 5	14.0	14 0	14 1	14 1	14 0	14 1	14 0	0 05
60		14.0	13.9	14.1	14.0	14 0	14.0		
		Calculated Air Change/Air Using Decay Data Above							
	0 34	0 32	0 34	0 33	0 33	0 34	0 33	0 33	0 006
		0 32	0 33	0 32	0 33	0 33	0 33		

Figure 1 Transfer of gas sample from plastic syringe into evacuated glass tube.

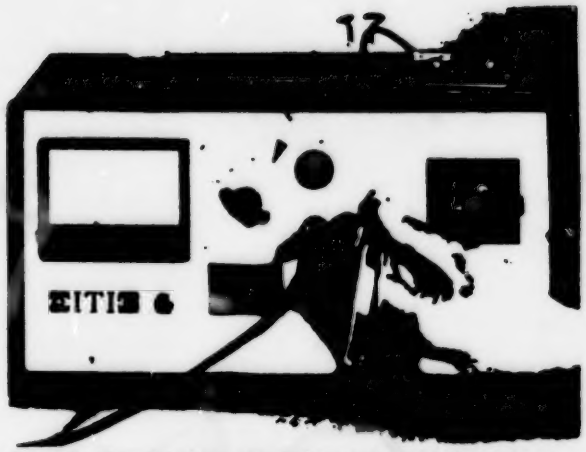


Figure 2 Transfer of gas sample from evacuated glass tube to inlet port of ion capture detector/chromatograph.

inserting the syringe into the plastic tubing and transferring its contents into the evacuated glass tubes. At each sampling time, therefore, twelve samples were collected in the evacuated glass tubes for storage stability tests. The gases in the evacuated glass tubes were analyzed after storage at room temperature for 0, 1, 3, 5, 7, 14 and 21 days. The SF_6 detector/chromatograph was calibrated with a prepared standard gas mixture prior to measuring the concentration of each set of samples. The first series of tests was conducted in the test house with air exchange induced by an exhaust fan; the second series with the house under natural air exchange caused by weather.

Details of the gas sampling and gas analysis procedures used for the tests are given in Appendix A.

The sample gas in the evacuated glass tube may be subjected to low or high temperature during transport from the test site to the laboratory. To check the stored gas samples under these conditions, which may cause leaks, and reaction of SF_6 with the surfaces of glass and rubber septum, five tubes with SF_6 of known concentration were subjected to −16°C and another five to 36°C for 24 hours. Five tubes were stored at room temperature to serve as a control set.

Because the gas samples were stored in the evacuated glass tubes with a pressure of one atmosphere (101.3 kPa) above ambient, glass breakage tests were conducted by striking the tube against a metal edge and noting the spread of glass after breakage. The evacuated glass tubes were pressurized by 0 to 1 atmosphere above ambient pressure in increments of 1/4 atmosphere (25 kPa).

Results and discussion

The results of the two series of tests (Tables 1 and 2) show that the calculated air exchange rates for the first test were 0.51 air changes per hour with direct measurement of N_2O concentration, 0.50 with direct measurement of SF_6 concentration and 0.50 with laboratory measurement of SF_6 using the evacuated glass tubes; for the second test they were 0.34, 0.34 and 0.32, respectively. The N_2O tracer gas was used as a comparative check on the air exchange rates as determined with the SF_6 tracer gas. The results validated the procedures used for taking a sample of SF_6/air mixture with the evacuated glass tubes and transferring it to the detector/chromatograph for analysis. The results also confirmed that there was so little air in the evacuated glass tubes that there was no significant effect on the reading of the SF_6 concentration in the sample.

There were no significant changes in the concentration of SF_6 samples after storage in the evacuated glass tubes for up to 21 days. The standard deviations were less than 0.1 percent of the mean concentrations and less than 2 percent of the mean air change rates. Table 3 gives the results of measurements of SF_6/air mixture stored in 15 evacuated glass tubes for 24 hours, with five subjected to an air

APPENDIX A

Procedures for Gas Sampling with Evacuated Glass Tubes and Measurement with Ion Capture Detector/Chromatograph

Gas Sample Collection

1. Check syringe for leaks

2. Flush the syringe once by drawing the plunger from 0 to 60 mL, and then push the plunger back to 0. The plunger will have to be moved slowly to allow the air to be drawn into or forced out of the syringe.

3. To collect a gas sample, slowly pull the plunger of the syringe to the 60 mL mark. Wait until the plunger is no longer drawn back and then push the plunger to the 50 mL mark.

4. Insert the needle of the syringe into the septum of the evacuated glass tube. The plunger will be drawn by the vacuum to about the 35 mL mark; failure to do so indicates a faulty evacuated glass tube. After the plunger stops, push it slowly to the 5 mL mark and hold it there for approximately 15 seconds.

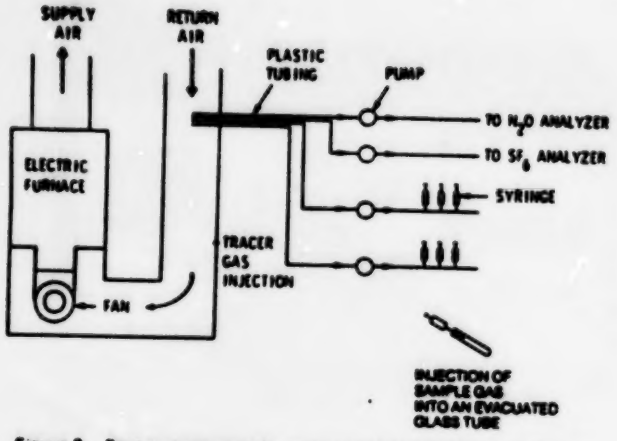


Figure 3 Test arrangement for collecting gas samples from the return air duct.

Table 3 Storage Stability Test Of SF_6 In Evacuated Glass Tubes Exposed For 24 Hours At – 18°C And 38°C

	SF_6 Concentration in Tube, ppb		
	Room Temp.	– 18°C	38°C
	14.2	14.1	14.2
	14.3	14.3	14.3
	14.3	14.4	14.4
	14.4	14.4	14.4
	14.3	14.3	14.3
	14.3	14.3	14.3
Mean			
Standard Deviation	0.09	0.12	0.08

temperature of −16°C, five to 38°C and the remaining five at room temperature. The results indicated that there were no significant changes in the SF_6 concentration when the evacuated glass tubes were exposed to these extreme conditions.

There were no breakages with normal handling of evacuated glass tubes. The breakage tests with pressures of 1/4, 1/2, 3/4, and 1 atmosphere (25, 50, 75, 101.3 kPa) above ambient, all resulted in a 2 m spread of glass shards. These tests repeated with evacuated glass tubes covered with a layer of 50 mm wide masking tape resulted in no spread of shards or sharp edges on the surface of the masking tape. This method of protection can be used where special precaution against accidental glass breakage is required.

Grab sampling with plastic syringes and evacuated glass tubes can also be applied in houses without a central warm air system. Initially, the house needs to be seeded with tracer gas from room to room, and gas samples collected during the decay period at a central location while operating floor fans to obtain a homogeneous mixture of tracer gas and air.[1,2]

Conclusions

- The sampling and measurement procedures with evacuated glass tubes for air exchange measurement with SF_6, described in Appendix A, were validated.
- Sample gases of SF_6 can be stored in the evacuated glass tubes for at least 21 days without significant changes in their concentrations.
- The results of the tests given in Tables 1, 2 and 3 indicated conclusively that the evacuated glass tubes are suitable for storage of SF_6 in concentrations normally encountered in air exchange measurements.

Acknowledgement

The authors acknowledge the contribution of J. Payer who assisted in planning and conducting the tests, and in the assimilation of test results. This paper is a contribution from the Division of Building Research, National Research Council of Canada, and is published with the approval of the Director of the Division.

References

1. Harrje, D.T., K. Gadsby and G. Linteris, "Sampling for Air Exchange: Rates in a Variety of Buildings," *ASHRAE Transactions 1982*, Vol. 88, Pt. 1.
2. Grot, R.A., "A Low-Cost Method for Measuring Air Infiltration Rates in a Large Sample of Dwellings," American Society for Testing and Materials, *Special Technical Publication 79*, 1980, pp. 50-59.
3. Freedman, R.W., W.G. Humphrey and R.L. Craft, "Use of Vacutainers for Collection of Mine Atmosphere Samples," Bureau of Mines Report of Investigations, 1975, RJ 7999.
4. Freedman, R.W. and B.I. Ferber, "Sampling Capability of Vacutainers for Fixed Gases and Low-Molecular-Weight Hydrocarbons," Bureau of Mines Report of Investigations, 1976, RI 8175

5. Remove the needle from the septum.
With this procedure the sample of gas in the evacuated glass tube is under pressure of about one atmosphere (101.3 kPa) above ambient pressure.

Gas Sample Measurement

1. Ensure that the sampling valve of the detector/chromatograph is in the off position.
2. Push the septum of the evacuated glass tube against the sampling valve needle of the detector/chromatograph to allow the sample gas to enter the sampling loop.
3. Wait 25 seconds for the sample to flush through the sample loop.
4. Remove the evacuated glass tube and immediately turn the sampling valve to the on position, hold it for 6 to 8 seconds, and then turn it back to the off position.
This step allows the carrier gas to transfer the sample gas in the sample loop to the column and the detector.

Addendum to NRCC 23055

Evaluation of Evacuated Glass Tubes for Sampling of SF_6/Air Mixture for Air Exchange Measurement, by G.T. Tamura and R.G. Evans.

Depending on the fit of the septum in the mouth of an evacuated glass tube, the sample gas, which is stored under pressure, may be lost because of popping of the septum. Before collecting a gas sample, precaution should be taken by securing the septum to the tube with a strong tape (masking tape is not adequate). The effectiveness of the method and the type of tape used for securing the septum should be checked before using evacuated glass tubes for air exchange measurements.

APPENDIX D

BOSS DATA FILE PRINTOUT

HOMEOWNER SURVEY
By House I.D.

House I.D.	Phone	Orig. Occ.	Own/ Rent	1 Age	1 Occ.	2 Age	2 Occ.	3 Age	3 Occ.	4 Age	4 Occ.	5 Age	5 Occ.	6 Age	6 Occ.	7 Age	7 Occ.	JOBS Occ.	JOBS Spouse	Cust. Home	Energy Price	Fut. Occ.	Market Value
0		2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	2	1	2	2
1		2	1	40	2	33	2	12	3	0	0	0	0	0	0	0	0	19	11	2	1	2	3
2		2	1	32	2	32	3	2	3	0	0	0	0	0	0	0	0	10	10	2	1	3	2
3		2	1	39	4	39	7	37	5	13	4	11	4	0	0	0	0	10	10	2	1	98	3
4		2	1	45	2	37	2	13	3	11	2	10	3	10	2	0	0	13	10	2	1	4	3
5		2	1	62	2	61	7	37	2	21	2	0	0	0	0	0	0	11	16	2	98	1	3
6		2	1	40	2	40	6	16	3	15	3	7	3	0	0	0	0	13	10	2	1	4	3
7		2	1	32	3	28	2	0	0	0	0	0	0	0	0	0	0	10	10	2	1	2	3
8		2	1	37	4	37	3	13	3	11	3	0	0	0	0	0	0	11	17	2	2	2	3
9		2	1	42	2	35	7	7	1	1	5	0	0	0	0	0	0	11	99	2	1	98	2
10		2	1	63	2	23	2	0	0	0	0	0	0	0	0	0	0	10	10	2	1	4	1
11		2	1	23	2	63	2	0	0	0	0	0	0	0	0	0	0	10	10	2	1	4	1
12		2	1	84	7	79	7	0	0	0	0	0	0	0	0	0	0	18	18	2	1	98	2
13		1	2	55	4	31	4	29	4	0	0	0	0	0	0	0	0	10	15	1	1	1	2
14		2	1	32	2	33	6	4	6	6	4	0	0	0	0	0	0	10	16	2	1	4	3
15		1	1	74	7	65	7	0	0	0	0	0	0	0	0	0	0	18	18	1	1	4	3
16		2	1	37	3	38	3	11	3	9	3	3	2	0	0	0	0	10	10	2	1	1	2
17		1	1	52	2	48	5	18	3	0	0	0	0	0	0	0	0	10	14	2	1	3	2
18		2	1	45	7	45	2	6	7	0	0	0	0	0	0	0	0	12	16	2	1	4	2
19		2	1	65	7	21	2	27	2	0	0	0	0	0	0	0	0	18	-1	2	2	98	2
20		1	1	65	7	41	2	0	0	0	0	0	0	0	0	0	0	18	10	2	1	4	2
21		1	1	65	5	65	3	0	0	0	0	0	0	0	0	0	0	18	18	2	98	98	2
22		2	1	48	2	45	2	18	3	17	3	0	0	0	0	0	0	15	14	2	1	3	2
23		2	1	13	7	17	5	38	3	43	2	1	7	0	0	0	0	15	14	2	1	98	2
24		2	1	19	2	17	2	12	2	40	7	41	2	0	0	0	0	15	16	2	1	98	2
25		2	1	32	2	32	6	9	3	8	3	4	7	0	0	0	0	99	16	2	1	2	2
26		2	1	28	4	0	0	0	0	0	0	0	0	0	0	0	0	10	-1	2	1	1	2
27		2	1	47	5	43	2	20	2	16	2	6	2	0	0	0	0	10	11	2	1	4	2
28		2	1	40	5	36	5	12	5	9	5	0	0	0	0	0	0	10	10	2	1	4	2
29		2	1	34	1	32	1	11	3	7	3	0	0	0	0	0	0	15	99	2	98	2	2
30		2	1	23	3	52	2	52	7	0	0	0	0	0	0	0	0	16	17	2	1	98	2
31		2	1	25	2	25	1	24	4	0	0	0	0	0	0	0	0	16	18	2	1	1	1
32		2	1	27	7	0	0	0	0	0	0	0	0	0	0	0	0	99	-1	2	1	1	2
33		2	1	48	7	48	2	0	0	0	0	0	0	0	0	0	0	11	13	2	2	4	2
34		1	1	67	4	72	4	0	0	0	0	0	0	0	0	0	0	18	18	2	1	2	2
35		2	1	55	2	58	5	60	3	0	0	0	0	0	0	0	0	19	16	2	1	4	2
36		2	1	50	2	48	4	0	0	0	0	0	0	0	0	0	0	12	14	2	1	2	2
37		2	1	65	7	67	7	0	0	0	0	0	0	0	0	0	0	18	18	2	3	3	2
38		2	1	62	7	63	0	24	2	0	0	0	0	0	0	0	0	15	16	2	98	98	2
39		1	1	47	2	40	6	15	2	10	3	0	0	0	0	0	0	16	17	1	1	2	2
40		2	1	62	7	62	3	45	2	0	0	0	0	0	0	0	0	99	16	2	1	4	2
41		2	1	66	7	26	2	0	0	0	0	0	0	0	0	0	0	18	-1	2	98	98	2
42		2	1	58	2	54	7	0	0	0	0	0	0	0	0	0	0	11	16	2	1	98	2

HOMEOWNER SURVEY
By House I.D.

House I.D.	Phone	Orig. Occ.	Own/ Rent	1 Age	1 Occ.	2 Age	2 Occ.	3 Age	3 Occ.	4 Age	4 Occ.	5 Age	5 Occ.	6 Age	6 Occ.	7 Age	7 Occ.	JOBS Occ.	Spouse	Cust. Home	Energy Price	Fut. Occ.	Market Value
43		2	1	53	2	58	4	0	0	0	0	0	0	0	0	0	0	10	99	2	1	2	2
44		2	1	17	2	19	2	46	2	43	4	0	0	0	0	0	0	10	99	2	98	2	4
45		1	3	55	4	21	3	55	2	0	0	0	0	0	0	0	0	13	16	1	1	4	3
46		1	1	45	5	55	2	19	2	17	2	15	2	13	2	8	2	10	10	1	1	4	3
47		2	1	50	2	45	7	18	2	12	2	0	0	0	0	0	0	10	16	2	2	4	4
48		2	1	72	3	71	2	0	0	0	0	0	0	0	0	0	0	18	16	2	1	1	4
49		2	1	28	2	29	2	1	2	0	0	0	0	0	0	0	0	10	10	2	1	2	1
50		2	1	65	4	68	5	0	0	0	0	0	0	0	0	0	0	18	18	2	1	2	2
51		2	1	55	2	52	2	22	2	0	0	0	0	0	0	0	0	13	14	2	1	3	3
52		1	1	53	5	54	7	0	0	0	0	0	0	0	0	0	0	10	10	1	1	4	2
53		2	1	40	2	40	2	8	3	10	3	50	4	0	0	0	0	10	10	2	1	4	3
54		1	1	65	4	65	4	0	0	0	0	0	0	0	0	0	0	18	13	2	1	3	2
55		2	1	26	2	23	2	0	0	0	0	0	0	0	0	0	0	10	16	2	1	1	2
56		1	1	52	1	46	7	21	7	0	0	0	0	0	0	0	0	15	16	1	1	4	2
57		2	1	69	3	0	0	0	0	0	0	0	0	0	0	0	0	18	-1	2	1	1	2
58		2	1	64	7	64	7	0	0	0	0	0	0	0	0	0	0	18	18	2	1	2	2
59		1	1	52	2	50	4	23	2	0	0	0	0	0	0	0	0	13	11	1	1	4	2
60		2	1	65	5	0	0	0	0	0	0	0	0	0	0	0	0	16	-1	2	1	98	2
61		1	1	50	7	55	5	0	0	0	0	0	0	0	0	0	0	12	18	2	1	4	2
62		2	2	29	4	0	0	0	0	0	0	0	0	0	0	0	0	17	-1	2	1	1	1
63		1	1	63	7	63	7	21	2	0	0	0	0	0	0	0	0	18	18	2	1	1	2
64		2	1	72	7	0	0	0	0	0	0	0	0	0	0	0	0	18	-1	2	1	98	2
65		2	1	69	5	65	5	0	0	0	0	0	0	0	0	0	0	18	16	2	1	98	2
66		1	1	39	7	42	2	9	2	7	2	0	0	0	0	0	0	16	11	1	1	4	2
67		2	1	70	7	70	7	19	4	0	0	0	0	0	0	0	0	18	16	2	1	2	2
68		2	1	53	4	50	7	0	0	0	0	0	0	0	0	0	0	11	16	2	1	4	2
69		1	1	55	7	58	7	0	0	0	0	0	0	0	0	0	0	15	16	2	1	4	2
70		2	1	57	7	57	2	83	7	89	7	0	0	0	0	0	0	15	16	2	1	98	2
71		2	1	84	7	84	7	52	2	0	0	0	0	0	0	0	0	10	-1	2	1	4	3
72		1	1	50	2	48	2	19	4	14	3	0	0	0	0	0	0	12	15	1	2	2	3
73		2	1	17	2	50	2	40	7	0	0	0	0	0	0	0	0	10	16	2	98	1	4
74		2	1	70	5	0	0	0	0	0	0	0	0	0	0	0	0	18	10	2	1	98	1
75		2	1	61	6	60	2	0	0	0	0	0	0	0	0	0	0	10	18	2	1	4	3
76		2	1	2	7	5	7	36	7	40	2	0	0	0	0	0	0	10	16	2	1	98	3
77		1	1	55	7	61	7	0	0	0	0	0	0	0	0	0	0	19	19	1	1	2	3
78		1	1	71	7	0	0	0	0	0	0	0	0	0	0	0	0	18	-1	2	1	98	2

HOMEOWNER SURVEY
By House I.D.

House I.D.	Const. Date	Pred. Clad.	Therm. Qual.	Wall Ins.	Attic Ins.	Energy 1	CONS. 2	3	4	5	Ins. Feat. 1	2	3	4	5	Outs. Feat. 1	2	4	4	5	Bl. Heat.	Heat. Att.	A.Q. Concrn	MOIST. Sum.
0	1900	1	2	2	5	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	2	97
1	1935	1	3	2	5	2	4	97	97	97	26	97	97	97	97	97	97	97	97	97	1	97	2	97
2	1952	1	1	1	5	2	97	97	97	97	99	30	97	97	97	97	97	97	97	97	1	97	1	97
3	1910	1	3	1	5	2	99	97	97	97	26	28	97	97	97	34	97	97	97	97	2	97	2	97
4	1930	1	2	4	2	6	97	97	97	97	97	97	97	97	97	33	97	97	97	97	1	97	2	97
5	1950	5	2	2	5	2	5	97	97	97	99	97	97	97	97	97	97	97	97	97	1	97	2	97
6	1924	1	3	1	2	3	6	97	97	97	99	97	97	97	97	32	97	97	97	97	1	97	2	97
7	1911	5	3	5	5	3	4	99	97	97	30	97	97	97	97	33	34	97	97	97	1	3	2	97
8	1912	5	3	4	5	2	5	97	97	97	97	97	97	97	97	99	97	97	97	97	2	97	1	97
9	1930	4	2	1	5	97	97	97	97	97	99	97	97	97	97	97	97	97	97	97	1	3	1	97
10	1918	4	3	2	2	2	6	97	97	97	30	97	97	97	97	97	97	97	97	97	1	97	2	97
11	1918	4	3	2	2	2	6	97	97	97	30	97	97	97	97	97	97	97	97	97	1	97	2	97
12	1922	3	3	6	5	5	6	97	97	97	97	97	97	97	97	33	97	97	97	97	1	3	2	97
13	1980	1	2	2	2	2	99	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	1	97
14	1922	2	3	1	5	99	97	97	97	97	97	97	97	97	97	34	97	97	97	97	1	97	2	97
15	1959	1	3	3	4	2	3	4	6	97	97	97	97	97	97	33	97	97	97	97	1	97	2	97
16	1960	1	2	2	5	2	97	97	97	97	97	97	97	97	97	33	97	97	97	97	1	97	2	97
17	1962	1	2	2	5	6	3	97	97	97	29	99	97	97	97	97	97	97	97	97	1	97	2	97
18	1964	1	2	2	5	2	4	97	97	97	99	97	97	97	97	32	33	97	97	97	2	97	2	97
19	1947	99	2	5	6	3	4	6	97	97	97	97	97	97	97	34	97	97	97	97	1	3	2	97
20	1948	5	2	99	5	6	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	99	1	97
21	1971	5	2	99	99	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	2	97
22	1955	1	2	2	5	2	4	6	97	97	99	97	97	97	97	99	97	97	97	97	1	97	2	97
23	1957	4	2	2	5	2	3	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	1	97
24	1917	1	3	3	3	1	4	97	97	97	97	97	97	97	97	97	97	97	97	97	2	97	2	97
25	1914	4	2	2	99	7	5	3	97	97	27	97	97	97	97	97	97	97	97	97	1	97	2	97
26	1955	1	3	2	5	3	97	97	97	97	27	97	97	97	97	97	97	97	97	97	2	97	2	97
27	1947	5	3	2	3	3	6	7	97	97	29	97	97	97	97	97	97	97	97	97	1	97	1	97
28	1906	2	2	6	3	3	4	97	97	97	97	97	97	97	97	97	97	97	97	97	2	97	2	97
29	1930	2	2	1	5	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	2	97	2	97
30	1950	1	2	2	5	2	4	6	7	97	30	97	97	97	97	32	97	97	97	97	1	97	1	97
31	1950	1	2	2	5	6	3	97	97	97	97	97	97	97	97	33	97	97	97	97	2	97	2	97
32	1957	4	3	99	99	97	97	97	97	97	97	99	97	97	97	97	97	97	97	97	1	3	2	97
33	1922	1	2	2	2	2	6	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	1	97
34	1944	1	3	2	6	3	6	7	97	97	97	97	97	97	97	33	35	97	97	97	2	97	2	97
35	1948	1	3	2	2	7	2	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	1	97
36	1952	4	3	4	2	3	6	99	97	97	97	97	97	97	97	97	97	97	97	97	2	97	2	97
37	1950	1	3	6	6	3	97	97	97	97	97	97	97	97	97	97	97	97	97	97	2	99	2	97
38	1946	5	2	2	2	3	4	5	6	7	97	97	97	97	97	97	97	97	97	97	2	97	1	97
39	1973	3	1	5	5	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	2	97
40	1910	1	2	99	99	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	2	97
41	1949	5	1	2	2	3	2	97	97	97	30	97	97	97	97	97	97	97	97	97	1	97	2	97
42	1920	1	3	6	2	2	4	97	97	97	97	97	97	97	97	97	97	97	97	97	1	99	2	97

HOMEOWNER SURVEY
By House I.D.

House I.D.	Const. Date	Pred. Clad.	Therm. Qual.	Wall Ins.	Attic Ins.	Energy 1	CONS. 2	3	4	5	Ins. Feat. 1	2	3	4	5	Outs. Feat. 1	2	4	4	5	Bl. Heat.	Heat. Att.	A.Q. Concrn	MOIST. Sum.
43	1972	1	1	2	2	6	3	4	97	97	97	97	97	97	97	34	33	97	97	97	1	97	1	97
44	1962	4	3	99	99	2	4	97	97	97	30	97	97	97	97	32	34	97	97	97	1	97	2	97
45	1971	4	3	2	2	2	4	97	97	97	29	97	97	97	97	97	97	97	97	97	1	97	2	97
46	1969	1	2	2	2	2	97	97	97	97	97	97	97	97	97	32	33	97	97	97	1	97	1	97
47	1959	1	2	2	2	2	3	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	2	97
48	1956	1	3	2	2	2	6	97	97	97	22	29	23	97	97	34	97	97	97	97	2	99	1	97
49	1941	5	2	2	2	2	97	97	97	97	24	97	97	97	97	33	97	97	97	97	1	97	1	97
50	1948	5	3	4	5	2	5	6	7	97	97	97	97	97	97	33	99	97	97	97	1	97	1	97
51	1902	4	2	3	2	2	97	97	97	97	97	97	97	97	97	33	97	97	97	97	1	3	2	97
52	1965	1	3	2	6	3	5	6	8	97	99	29	97	97	97	97	97	97	97	97	1	99	1	97
53	1930	5	3	2	2	2	5	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	2	97
54	1950	1	2	2	6	99	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	2	97
55	1930	1	3	2	5	4	5	6	97	97	30	97	97	97	97	33	34	97	97	97	1	97	2	97
56	1944	1	3	2	6	99	3	97	97	97	99	97	97	97	97	97	97	97	97	97	1	97	1	97
57	1949	1	3	2	2	2	4	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	2	97
58	1950	1	3	2	2	2	3	6	7	4	97	97	97	97	97	97	97	97	97	97	1	97	1	97
59	1947	5	3	2	2	2	3	4	5	6	30	97	97	97	97	33	97	97	97	97	1	97	2	97
60	1947	99	1	2	3	5	2	4	97	97	97	97	97	97	97	33	97	97	97	97	2	99	1	97
61	1959	1	3	3	3	3	97	97	97	97	97	97	97	97	97	99	97	97	97	97	1	97	2	97
62	1945	5	2	2	2	97	97	97	97	97	99	97	97	97	97	33	34	97	97	97	1	97	1	97
63	1947	4	3	2	3	2	5	97	97	97	97	97	97	97	97	33	97	97	97	97	1	3	2	97
64	1957	1	3	99	3	6	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	2	97
65	1947	1	3	2	5	3	4	97	97	97	97	97	97	97	97	33	97	97	97	97	2	99	2	97
66	1972	1	3	2	2	3	6	4	97	97	29	97	97	97	97	34	97	97	97	97	2	97	2	97
67	1910	4	2	99	99	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	1	97
68	1932	1	1	3	6	3	4	7	97	97	28	99	97	97	97	97	97	97	97	97	2	97	2	97
69	1956	1	3	2	2	3	4	6	97	97	97	97	97	97	97	97	97	97	97	97	1	97	1	97
70	1957	1	2	2	2	2	5	4	97	97	97	97	97	97	97	97	97	97	97	97	1	97	1	97
71	1968	1	2	2	6	7	6	4	3	97	97	97	97	97	97	97	97	97	97	97	1	97	1	97
72	1974	1	2	2	3	2	3	6	99	4	99	29	97	97	97	97	97	97	97	97	2	97	1	97
73	1968	2	3	3	3	2	4	97	97	97	28	97	97	97	97	97	97	97	97	97	2	97	1	97
74	1918	3	3	4	2	3	5	6	4	97	97	97	97	97	97	33	97	97	97	97	1	97	1	97
75	1957	1	3	2	5	2	3	4	5	7	97	97	97	97	97	33	97	97	97	97	1	3	1	97
76	1976	4	2	2	2	3	4	6	97	97	97	97	97	97	97	32	97	97	97	97	2	97	1	97
77	1961	1	3	2	5	3	4	6	99	97	30	97	97	97	97	34	99	97	97	97	1	97	2	97
78	1946	3	3	3	2	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	2	97	2	97

HOMEOWNER SURVEY
By House I.D.

House I.D.	WNDW. Wntr.	CEIL. Sum.	Wntr.	SENS. Sum.	Wntr.	DOORS Sum.	Wntr.	BSMNT Sum.	Wntr.	OTHER Sum.	Wntr.	ODORS Sum.	KITCH. Wntr.	BATH. Sum.	Wntr.	OTHER Sum.	Wntr.	DRY Sum.	SENS. Wntr.	ELEC. Sum.
0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
1	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
2	97	97	97	97	97	97	97	97	97	97	2	97	97	97	97	97	97	97	97	97
3	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
4	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
5	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
6	97	97	97	97	97	97	97	2	97	97	97	97	97	97	97	97	97	97	97	97
7	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
8	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
9	97	97	97	97	97	97	97	2	2	97	97	97	97	97	97	97	97	97	97	97
10	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
11	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
12	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
13	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
14	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
15	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
16	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
17	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
18	2	97	97	97	97	1	97	97	97	97	97	97	97	97	97	97	97	97	97	97
19	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
20	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
21	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
22	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
23	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
24	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	2	97
25	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
26	97	97	97	97	97	97	97	97	97	97	97	97	97	2	97	97	97	97	97	97
27	3	97	97	97	97	97	2	97	97	97	97	97	97	97	97	97	97	97	97	97
28	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
29	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
30	2	97	97	97	2	1	3	97	97	97	97	97	97	97	97	1	3	97	97	97
31	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
32	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
33	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97
34	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
35	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
36	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
37	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
38	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
39	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97	97	97
40	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
41	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
42	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97

HOMEOWNER SURVEY
By House I.D.

House I.D.	WNDW. Wntr.	CEIL. Sum.	CEIL. Wntr.	SENS. Sum.	SENS. Wntr.	DOORS Sum.	DOORS Wntr.	BSMNT Sum.	BSMNT Wntr.	OTHER Sum.	OTHER Wntr.	ODORS Sum.	KITCH. Wntr.	BATH. Sum.	BATH. Wntr.	OTHER Sum.	OTHER Wntr.	DRY Sum.	SENS. Wntr.	ELEC. Sum.
43	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
44	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
45	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
46	2	97	97	97	97	97	1	97	97	97	97	97	97	97	97	97	97	97	97	97
47	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
48	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
49	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
50	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
51	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	-1	97	97	97
52	97	97	1	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	3
53	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
54	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
55	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
56	3	97	1	3	3	1	2	97	97	1	3	2	2	2	2	97	97	97	97	97
57	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
58	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
59	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	99	97	97	97
60	97	97	97	97	97	97	97	97	1	97	97	97	97	97	97	97	1	97	97	97
61	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97
62	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
63	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97
64	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
65	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
66	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
67	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
68	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	1	97
69	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
70	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	2	97
71	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	3	97
72	3	97	97	97	97	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97
73	97	97	97	97	97	97	97	97	97	97	97	2	2	97	97	97	97	97	97	97
74	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
75	1	97	1	97	1	97	97	97	97	97	97	97	97	97	97	97	99	97	97	97
76	97	97	97	97	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
77	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
78	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97

HOMEOWNER SURVEY
By House I.D.

House I.D.	OTHER Wntr.	OTHER Sum.	DRAFT Wntr.	DRAFT Sum.	DRAFT Wntr.	H/L Rn	Rn Fact	Cig. /Day	Pip. /Cig	Plants	Spider	LIV. 1	ROOM 2	ROOM 3	ROOM 4	ROOM 5	ROOM 6	BSMNT 1	BSMNT 2	BSMNT 3	BSMNT 4	BSMNT 5	BSMNT 6	BEDR. 1	BEDR. 2	BEDR. 3	BEDR. 4	BEDR. 5
0	97	97	97	97	97	2	2	0	2	0	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
1	97	97	97	97	97	2	1	0	2	15	4	16	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
2	2	97	97	2	2	2	2	0	1	3	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
3	97	97	97	97	97	2	2	50	2	3	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
4	97	97	97	97	97	2	1	0	2	20	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
5	97	97	97	97	97	2	2	0	2	50	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
6	97	97	97	97	97	2	2	0	2	6	1	99	97	97	97	97	97	11	97	97	97	97	97	97	97	97	97	97
7	97	97	97	97	97	2	2	0	2	40	0	11	12	13	14	16	97	97	97	97	97	97	97	11	12	13	14	16
8	97	97	97	97	97	2	2	0	2	12	0	99	97	97	97	97	97	97	97	97	97	97	97	99	97	97	97	97
9	97	97	97	97	97	2	1	0	2	15	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
10	97	97	97	97	97	2	2	0	2	1	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
11	97	97	97	97	97	2	2	0	2	1	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
12	97	97	97	97	97	2	2	0	2	4	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
13	97	97	97	97	97	1	1	30	2	3	0	16	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
14	97	97	97	97	97	2	1	0	2	29	0	97	97	97	97	97	97	14	97	97	97	97	97	14	97	97	97	97
15	97	97	97	97	97	2	2	0	2	12	0	11	12	13	97	97	97	12	97	97	97	97	97	11	12	13	97	97
16	97	97	97	97	97	2	2	0	2	10	1	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
17	97	97	97	97	97	2	2	0	2	3	1	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
18	97	97	97	97	97	2	2	35	2	14	1	11	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
19	97	97	97	97	97	2	2	12	2	4	0	97	97	97	97	97	97	97	97	97	97	97	97	16	97	97	97	97
20	97	97	97	97	1	2	2	0	2	0	0	11	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
21	97	97	97	97	97	2	2	15	2	5	0	16	13	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
22	97	97	97	97	97	2	2	10	2	9	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
23	97	97	97	97	97	2	2	0	2	8	0	97	97	97	97	97	97	15	97	97	97	97	97	97	97	97	97	97
24	97	97	97	97	97	2	2	19	2	5	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
25	97	97	97	97	97	2	2	10	2	70	2	15	97	97	97	97	97	97	97	97	97	97	97	12	14	97	97	97
26	97	97	97	97	97	2	2	20	2	3	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
27	97	97	97	97	1	2	2	10	2	2	0	16	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
28	97	97	97	97	97	2	1	0	2	12	0	97	97	97	97	97	97	97	97	97	97	97	97	99	97	97	97	97
29	97	97	97	97	97	2	2	0	2	30	0	14	97	97	97	97	97	99	97	97	97	97	97	97	97	97	97	97
30	97	97	97	97	1	2	2	0	2	16	4	12	16	99	97	97	97	97	97	97	97	97	97	12	97	97	97	97
31	97	97	97	97	97	2	2	15	2	15	2	12	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
32	97	97	97	97	97	2	1	25	2	3	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
33	1	97	97	97	2	2	2	50	2	0	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
34	97	97	97	97	97	2	2	0	2	12	0	12	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
35	97	97	97	97	97	2	2	0	2	6	1	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
36	97	97	97	97	97	2	2	0	2	6	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
37	97	97	97	97	97	2	2	0	2	40	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
38	97	97	97	97	97	2	2	20	2	50	3	11	12	16	99	97	97	97	97	97	97	97	97	97	97	97	97	97
39	97	97	97	97	97	2	2	0	2	10	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
40	97	97	97	97	97	2	2	25	2	30	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
41	97	97	97	97	97	2	2	6	2	0	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
42	97	97	97	97	97	2	2	0	2	20	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97

HOMEOWNER SURVEY
By House I.D.

House I.D.	OTHER Wntr.	OTHER Sum.	DRAFT Wntr.	DRAFT Sum.	H/L Wntr.	Rn	Rn Fact	Cig. /Day	Pip. /Cig	Plants	Spider	LIV. 1	ROOM 2	3	4	5	6	BSMNT 1	2	3	4	5	6	BEDR. 1	2	3	4	5
43	97	97	97	97	1	2	2	15	2	1	0	97	97	97	97	97	97	97	97	97	97	97	97	12	16	97	97	97
44	97	97	97	97	97	2	2	0	2	25	0	16	97	97	97	97	97	97	97	97	97	97	97	16	97	97	97	97
45	97	97	97	97	97	2	2	0	2	6	0	97	97	97	97	97	97	12	15	97	97	97	97	16	97	97	97	97
46	97	97	97	97	97	2	2	0	2	5	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
47	97	97	97	97	97	2	2	0	2	8	0	16	11	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
48	97	97	97	97	97	2	1	0	2	9	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
49	97	97	97	97	1	2	2	8	2	20	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
50	97	97	97	97	97	98	2	15	2	6	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
51	2	97	97	1	1	2	2	0	2	30	0	16	12	14	97	97	97	97	97	97	97	97	97	97	97	97	97	97
52	97	97	97	97	97	2	1	0	2	100	1	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
53	97	97	97	97	97	2	2	0	2	20	1	11	12	13	16	97	97	97	97	97	97	97	97	97	97	97	97	97
54	97	97	97	97	97	2	2	0	2	10	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
55	97	97	97	97	97	2	2	0	2	0	0	16	97	97	97	97	97	16	97	97	97	97	97	97	97	97	97	97
56	97	97	97	97	97	2	2	0	2	12	1	97	97	97	97	97	97	97	97	97	97	97	97	99	97	97	97	97
57	97	97	97	97	97	2	2	25	2	2	0	16	97	97	97	97	97	97	97	97	97	97	97	16	97	97	97	97
58	97	97	97	97	97	2	2	0	2	20	1	97	97	97	97	97	97	97	97	97	97	97	97	13	97	97	97	97
59	97	97	97	97	1	2	2	13	2	15	0	97	97	97	97	97	97	12	15	97	97	97	97	97	97	97	97	97
60	97	97	97	97	97	2	2	0	2	3	1	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
61	97	97	97	97	97	2	2	3	2	9	0	12	15	16	97	97	97	97	97	97	97	97	97	12	97	97	97	97
62	97	97	97	97	2	2	2	0	2	14	0	16	99	97	97	97	97	97	97	97	97	97	97	11	97	97	97	97
63	97	97	97	97	97	2	2	0	2	2	0	97	97	97	97	97	97	97	97	97	97	97	97	16	11	97	97	97
64	97	97	97	97	97	2	2	0	2	12	1	11	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
65	97	97	97	97	97	2	2	50	2	7	0	11	12	13	97	97	97	97	97	97	97	97	97	97	97	97	97	97
66	97	97	97	97	97	2	2	10	1	11	0	97	97	97	97	97	97	16	97	97	97	97	97	97	97	97	97	97
67	97	97	97	97	97	2	1	0	2	55	1	12	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
68	97	97	97	97	97	2	1	30	2	13	2	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
69	97	97	97	97	97	2	2	0	2	10	0	14	97	97	97	97	97	15	99	97	97	97	97	97	97	97	97	97
70	97	97	97	97	97	2	2	0	2	7	1	11	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
71	97	97	97	97	1	1	1	0	2	6	0	12	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
72	97	97	97	97	2	2	2	0	2	7	0	12	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
73	97	97	97	97	2	2	2	0	2	8	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
74	97	97	97	97	97	2	2	0	2	5	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
75	97	97	97	97	1	2	2	0	2	6	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
76	97	97	97	2	2	2	1	0	2	2	0	12	13	97	97	97	97	12	13	14	97	97	97	12	97	97	97	97
77	97	97	97	97	97	2	1	0	2	12	0	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97	97
78	97	97	97	97	97	2	2	0	2	4	0	11	12	13	97	97	97	14	97	97	97	97	97	11	13	14	97	97

HOMEOWNER SURVEY
By House I.D.

House I.D.	HOBBY 6	1	2	3	4	Wtr. Srce	Dryer Vent.	Lint Scr.	Air Con.	Air Cln.	Hum.	Frcd. Air	FAN Con.	Mult.	Fltr Chng	BSMT Cold	Warm	LIV. Cold	RM. Warm	BEDR Cold	Warm	Stv. Frpl	DOOR 1	2	3	AIR 1
0	97	97	97	97	97	1	2	-1	2	2	2	1	2	2	98	1	1	2	2	2	2	0	-1	-1	-1	-1
1	97	42	99	97	97	1	3	1	2	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	97	-1	-1	1
2	97	97	97	97	97	1	2	-1	1	2	2	1	2	2	98	1	1	1	1	2	2	0	-1	-1	-1	-1
3	97	97	97	97	97	1	2	-1	2	1	2	2	-1	-1	-1	1	1	2	2	2	2	2	1	3	-1	4
4	97	97	97	97	97	1	2	-1	2	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	97	-1	-1	1
5	97	99	97	97	97	1	2	-1	1	2	1	1	2	98	98	1	1	2	1	2	1	1	3	-1	-1	1
6	97	99	97	97	97	1	1	1	2	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	3	-1	-1	1
7	97	97	97	97	97	1	1	2	2	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	-1	-1	1
8	97	97	97	97	97	1	2	-1	1	2	1	1	2	2	98	1	1	2	2	2	2	0	-1	-1	-1	-1
9	97	44	99	97	97	1	2	-1	2	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	2	-1	-1	1
10	97	97	97	97	97	1	2	-1	2	2	1	1	1	2	3	1	1	2	2	2	2	0	-1	-1	-1	-1
11	97	97	97	97	97	1	2	-1	2	2	1	1	1	2	3	1	1	2	2	2	2	0	-1	-1	-1	-1
12	97	97	97	97	97	1	2	-1	1	2	2	1	2	2	3	1	1	2	2	2	2	0	-1	-1	-1	-1
13	97	44	97	97	97	1	3	1	2	2	1	1	2	2	3	1	1	2	2	2	2	1	2	-1	-1	4
14	97	97	97	97	97	1	2	-1	2	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1
15	97	97	97	97	97	1	2	-1	1	2	1	1	2	2	98	1	1	2	2	2	2	0	-1	-1	-1	-1
16	97	97	97	97	97	1	-1	-1	2	2	2	1	2	2	98	3	3	2	2	2	2	0	-1	-1	-1	-1
17	97	97	97	97	97	1	2	-1	1	2	2	1	1	1	98	2	1	2	2	2	2	0	-1	-1	-1	-1
18	97	97	97	97	97	1	2	-1	1	2	1	1	2	2	98	1	1	2	2	2	2	0	-1	-1	-1	-1
19	97	99	97	97	97	1	3	1	1	2	1	1	2	2	-1	-1	-1	2	2	2	2	0	-1	-1	-1	-1
20	97	97	97	97	97	1	2	-1	1	2	2	1	2	2	98	-1	-1	2	2	2	2	0	-1	-1	-1	-1
21	97	97	97	97	97	1	2	-1	1	2	1	1	1	2	1	1	1	2	2	2	2	0	-1	-1	-1	-1
22	97	97	97	97	97	1	2	-1	1	2	1	1	2	2	4	1	1	2	2	2	2	0	-1	-1	-1	-1
23	97	97	97	97	97	1	2	-1	2	2	2	1	2	2	4	2	2	2	2	2	2	0	-1	-1	-1	-1
24	97	44	97	97	97	1	2	-1	2	2	1	1	2	2	4	1	1	2	2	2	2	0	-1	-1	-1	-1
25	97	44	99	97	97	1	3	1	2	2	2	1	2	2	4	2	1	2	2	2	2	0	-1	-1	-1	-1
26	97	97	97	97	97	1	2	-1	2	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	2	-1	-1	4
27	97	97	97	97	97	1	2	-1	1	2	2	1	2	1	5	1	1	2	2	2	2	0	-1	-1	-1	-1
28	97	97	97	97	97	1	2	-1	1	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	4	-1	-1	1
29	97	97	97	97	97	1	-1	-1	2	2	1	1	2	98	98	1	1	2	2	2	2	0	-1	-1	-1	-1
30	97	97	97	97	97	1	2	-1	2	2	2	1	2	2	98	1	1	2	1	2	1	0	-1	-1	-1	-1
31	97	97	97	97	97	1	-1	-1	2	2	2	1	2	2	98	1	1	2	2	2	2	0	-1	-1	-1	-1
32	97	99	97	97	97	1	2	-1	2	2	2	1	2	2	98	1	1	2	2	2	2	0	-1	-1	-1	-1
33	97	97	97	97	97	1	2	-1	2	2	1	1	2	2	4	1	1	2	2	2	2	0	-1	-1	-1	-1
34	97	97	97	97	97	1	2	-1	2	2	2	1	2	2	3	1	1	2	2	2	2	0	-1	-1	-1	-1
35	97	97	97	97	97	1	2	-1	1	1	2	1	1	1	98	1	1	2	1	2	1	0	-1	-1	-1	-1
36	97	99	97	97	97	1	2	-1	1	1	1	1	1	1	98	1	1	2	2	2	2	1	3	-1	-1	2
37	97	42	97	97	97	1	2	-1	1	2	1	1	2	2	98	4	1	3	3	3	3	0	-1	-1	-1	-1
38	97	99	97	97	97	1	2	-1	1	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1
39	97	97	97	97	97	1	-1	-1	2	2	1	1	2	2	98	1	1	2	2	2	2	0	-1	-1	-1	-1
40	97	42	97	97	97	1	2	-1	2	2	2	1	2	2	98	1	1	2	2	2	2	0	-1	-1	-1	-1
41	97	97	97	97	97	1	-1	-1	2	2	2	1	2	2	3	1	1	2	2	2	2	0	-1	-1	-1	-1
42	97	97	97	97	97	1	2	-1	1	2	1	1	2	1	5	1	1	2	2	2	2	0	-1	-1	-1	-1

HOMEOWNER SURVEY
By House I.D.

House I.D.	6	HOBBY 1	2	3	4	Wtr. Srce	Dryer Vent.	Lint Scr.	Air Con.	Air Cln.	Hum.	Frcd. Air	FAN Con.	Mult.	Fltr Chng	BSMT Cold	BSMT Warm	LIV. Cold	RM. Warm	BEDR Cold	BEDR Warm	Stv. Frpl	DOOR 1	DOOR 2	DOOR 3	AIR 1
43	97	97	97	97	97	1	2	-1	1	2	2	1	2	2	5	1	1	2	2	2	2	1	1	-1	-1	1
44	97	97	97	97	97	1	2	-1	1	2	1	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	3	-1	-1	1
45	97	44	41	97	97	1	2	-1	2	2	2	2	-1	-1	-1	-1	2	-1	2	-1	2	0	-1	-1	-1	-1
46	97	97	97	97	97	1	2	-1	2	2	1	1	2	2	3	1	1	2	2	2	2	1	3	-1	-1	1
47	97	97	97	97	97	1	2	-1	1	1	1	1	1	1	5	1	1	2	2	2	2	2	2	2	-1	1
48	97	97	97	97	97	1	2	-1	1	1	1	1	1	1	5	1	1	2	2	2	2	2	97	3	-1	1
49	97	42	97	97	97	1	2	-1	2	2	2	1	2	2	98	1	1	2	2	2	2	0	-1	-1	-1	-1
50	97	97	97	97	97	1	2	-1	1	2	1	1	1	1	5	1	1	2	2	1	1	0	-1	-1	-1	-1
51	97	97	97	97	97	1	2	-1	2	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	4	-1	-1	1
52	97	97	97	97	99	1	4	1	2	2	2	2	-1	-1	98	-1	-1	2	1	2	1	1	99	-1	-1	2
53	97	97	97	97	97	1	1	2	1	2	1	1	2	2	98	1	1	2	2	2	2	1	3	-1	-1	1
54	97	97	97	97	97	1	1	1	2	2	2	1	2	2	98	1	1	2	1	2	1	0	-1	-1	-1	-1
55	97	99	97	97	97	1	3	1	2	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1
56	97	99	97	97	97	1	2	-1	1	2	2	1	1	2	5	1	1	2	2	2	2	0	-1	-1	-1	-1
57	97	97	97	97	97	1	2	-1	2	2	2	1	2	2	5	1	1	2	2	2	2	0	-1	-1	-1	-1
58	97	44	97	97	97	1	2	-1	1	1	1	1	1	1	5	1	1	2	2	2	2	0	-1	-1	-1	-1
59	97	42	46	97	97	1	2	-1	1	2	2	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1
60	97	97	97	97	97	1	2	-1	1	2	2	1	2	2	3	-1	-1	1	1	1	1	0	-1	-1	-1	-1
61	97	97	97	97	97	1	2	-1	1	2	2	1	2	98	5	1	1	2	2	2	2	0	-1	-1	-1	-1
62	97	97	97	97	97	1	2	-1	2	2	1	1	2	2	3	1	1	2	2	2	2	0	-1	-1	-1	-1
63	97	97	97	97	97	1	2	-1	2	2	1	1	2	2	5	-1	-1	2	2	2	2	0	-1	-1	-1	-1
64	97	97	97	97	97	1	2	-1	1	2	2	1	2	2	4	1	1	2	2	2	2	0	-1	-1	-1	-1
65	97	97	97	97	97	1	1	1	1	2	2	1	2	2	4	-1	-1	2	2	2	2	0	-1	-1	-1	-1
66	97	97	97	97	97	1	2	-1	1	1	1	1	1	1	5	1	1	2	2	2	2	1	3	-1	-1	1
67	97	97	97	97	97	1	1	1	2	2	1	1	2	2	3	-1	-1	2	2	2	2	1	99	-1	-1	99
68	97	97	97	97	97	1	2	-1	1	1	2	1	2	2	5	2	2	2	2	2	2	1	3	-1	-1	1
69	97	97	97	97	97	1	2	-1	2	2	2	1	2	2	5	1	1	2	2	2	2	0	-1	-1	-1	-1
70	97	45	97	97	97	1	2	-1	2	2	2	1	2	2	4	1	1	2	2	2	2	0	-1	-1	-1	-1
71	97	97	97	97	97	1	2	-1	1	1	1	1	1	1	98	1	1	2	2	2	2	1	2	-1	-1	2
72	97	97	97	97	97	1	2	-1	1	2	1	1	2	2	98	1	1	2	2	2	2	1	3	-1	-1	2
73	97	97	97	97	97	1	2	-1	1	2	1	1	2	98	4	1	1	2	2	2	2	1	3	-1	-1	2
74	97	97	97	97	97	1	1	1	2	2	1	1	2	1	5	1	1	2	2	2	2	0	-1	-1	-1	-1
75	97	97	97	97	97	1	2	-1	1	2	2	1	2	2	4	-1	-1	2	2	2	2	0	-1	-1	-1	-1
76	97	97	97	97	97	1	1	2	1	2	1	1	1	2	3	4	1	2	2	2	2	1	1	-1	-1	1
77	97	97	97	97	97	1	2	-1	2	2	1	1	2	2	98	1	1	2	2	2	2	0	-1	-1	-1	-1
78	97	97	97	97	97	1	2	-1	1	2	1	1	2	2	5	1	1	2	2	2	2	0	-1	-1	-1	-1

HOMEOWNER SURVEY
By House I.D.

House I.D.	SUP. 2	SUP. 3	EQUIP. 1	USE Deh.	Clnr	HRVs	HRVw	Bl(w)	Bl(s)	A/C	Fp(w)	Fp(s)	ENV. 1	FACT 2	FACT 3	FAN 1	Reas 2	Reas 3	Reas 4	Reas 5	Reas 1	Reas 2	Reas 3	Reas 4	Reas 5	Noise 1	Noise 2	Noise 3	Noise 4
0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	97	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	3	97	97	97	2	2	3	-1	-1	-1	-1	-1	-1	-1	2	2	2	-1
2	-1	-1	-1	-1	-1	-1	-1	1	2	2	-1	-1	97	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
3	1	-1	-1	-1	3	-1	-1	-1	-1	-1	-1	-1	97	97	97	3	2	2	-1	-1	-1	-1	-1	-1	-1	3	2	2	-1
4	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	3	1	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
5	-1	-1	2	-1	-1	-1	-1	2	3	1	2	3	97	97	97	2	3	2	-1	-1	-1	-1	-1	-1	-1	3	1	1	-1
6	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	2	3	97	97	97	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1
7	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	2	3	97	97	97	2	3	2	-1	-1	-1	-1	-1	-1	-1	4	2	3	-1
8	-1	-1	1	-1	-1	-1	-1	2	3	2	-1	-1	97	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
9	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	97	97	97	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	4	-1	-1	-1
10	-1	-1	2	-1	-1	-1	-1	2	1	-1	-1	-1	1	5	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
11	-1	-1	2	-1	-1	-1	-1	2	1	-1	-1	-1	1	5	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
12	-1	-1	1	-1	-1	-1	-1	2	2	2	-1	-1	97	97	97	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	-1
13	-1	-1	2	-1	-1	-1	-1	2	3	-1	2	3	1	2	97	3	3	3	-1	-1	-1	-1	-1	-1	-1	3	2	2	-1
14	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	5	97	97	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	3	-1	-1	-1
15	-1	-1	1	-1	-1	-1	-1	2	2	2	-1	-1	97	97	97	2	-1	-1	-1	-1	99	-1	-1	-1	-1	1	-1	-1	-1
16	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	-1	-1	97	97	97	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	-1
17	-1	-1	-1	-1	-1	-1	-1	1	1	2	-1	-1	2	97	97	3	3	-1	-1	-1	-1	-1	-1	-1	-1	4	3	-1	-1
18	-1	-1	3	-1	-1	-1	-1	2	3	2	2	3	6	97	97	1	3	-1	-1	-1	1	-1	-1	-1	-1	1	1	-1	-1
19	-1	-1	1	-1	-1	-1	-1	2	3	2	-1	-1	99	97	97	3	1	-1	-1	-1	-1	99	-1	-1	-1	2	1	-1	-1
20	-1	-1	1	-1	-1	-1	-1	2	3	2	-1	-1	97	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
21	-1	-1	1	-1	-1	-1	-1	1	1	1	-1	-1	1	97	97	2	-1	-1	-1	-1	2	-1	-1	-1	-1	4	-1	-1	-1
22	-1	-1	3	-1	-1	-1	-1	2	2	2	-1	-1	1	2	97	2	3	-1	-1	-1	-1	-1	-1	-1	-1	3	1	-1	-1
23	-1	-1	-1	-1	-1	-1	-1	1	3	-1	-1	-1	1	2	97	2	2	-1	-1	-1	-1	-1	-1	-1	-1	2	2	-1	-1
24	-1	-1	1	-1	-1	1	1	2	3	-1	-1	-1	1	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
25	-1	-1	-1	-1	-1	-1	-1	1	3	-1	-1	-1	1	97	97	2	2	-1	-1	-1	99	-1	-1	-1	-1	1	1	-1	-1
26	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	2	3	2	1	97	1	2	-1	-1	-1	99	-1	-1	-1	-1	3	1	-1	-1
27	-1	-1	-1	-1	-1	-1	-1	2	3	2	-1	-1	2	97	97	2	-1	-1	-1	-1	99	-1	-1	-1	-1	3	-1	-1	-1
28	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	2	-1	5	99	97	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1
29	-1	-1	2	-1	-1	-1	-1	2	3	-1	-1	-1	97	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
30	-1	-1	-1	1	-1	-1	-1	2	3	-1	-1	-1	97	97	97	2	-1	-1	-1	-1	1	-1	-1	-1	-1	1	-1	-1	-1
31	-1	-1	-1	-1	-1	-1	-1	2	3	-1	-1	-1	1	99	97	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1
32	-1	-1	-1	-1	-1	-1	-1	2	3	-1	-1	-1	97	97	97	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	-1
33	-1	-1	1	-1	-1	-1	-1	2	2	-1	-1	-1	97	97	97	2	2	-1	-1	-1	-1	-1	-1	-1	-1	4	3	-1	-1
34	-1	-1	-1	-1	-1	-1	-1	1	2	-1	-1	-1	97	97	97	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1
35	-1	-1	-1	-1	1	-1	-1	1	1	1	-1	-1	2	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
36	-1	-1	1	-1	1	-1	-1	1	1	1	2	3	97	97	97	1	-1	-1	-1	-1	1	-1	-1	-1	-1	4	-1	-1	-1
37	-1	-1	1	-1	-1	-1	-1	2	2	2	-1	-1	1	99	97	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	-1
38	-1	-1	1	1	-1	-1	-1	-1	-1	2	-1	-1	1	3	97	2	1	2	-1	-1	-1	99	-1	-1	-1	2	2	2	-1
39	-1	-1	2	-1	-1	-1	-1	2	3	-1	-1	-1	2	97	97	2	3	-1	-1	-1	-1	-1	-1	-1	-1	2	1	-1	-1
40	-1	-1	-1	-1	-1	-1	-1	2	3	-1	-1	-1	1	2	97	1	2	3	-1	-1	-1	-1	-1	-1	-1	4	4	4	-1
41	-1	-1	-1	-1	-1	-1	-1	2	3	-1	-1	-1	1	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
42	-1	-1	3	-1	-1	-1	-1	2	3	2	-1	-1	97	97	97	4	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1

HOMEOWNER SURVEY
By House I.D.

House I.D.	SUP. 2	3	EQUIP. 1	USE Deh.	Clnr	HRVs	HRVw	Bl(w)	Bl(s)	A/C	Fp(w)	Fp(s)	ENV. 1	FACT 2	3	FAN 1	2	3	4	5	Reas 1	2	3	4	5	Noise 1	2	3	4
43	-1	-1	-1	-1	-1	-1	-1	2	2	1	2	3	4	97	97	1	1	3	2	-1	3	-1	-1	-1	-1	4	3	4	2
44	-1	-1	3	-1	-1	-1	-1	-1	-1	1	2	3	97	97	97	1	1	-1	-1	-1	2	2	-1	-1	-1	4	4	-1	-1
45	-1	-1	-1	2	-1	-1	-1	-1	-1	-1	-1	-1	3	4	97	4	4	-1	-1	-1	-1	-1	-1	-1	-1	1	1	-1	-1
46	-1	-1	1	-1	-1	-1	-1	2	3	-1	2	3	97	97	97	2	3	2	-1	-1	-1	-1	-1	-1	-1	3	3	1	-1
47	4	-1	1	-1	1	-1	-1	1	1	2	3	2	97	97	97	1	3	2	2	2	-1	-1	-1	-1	-1	1	2	2	2
48	1	-1	1	-1	1	-1	-1	1	1	2	2	3	97	97	97	1	2	1	3	1	2	2	2	2	2	2	2	2	1
49	-1	-1	-1	-1	-1	-1	-1	2	2	-1	-1	-1	5	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
50	-1	-1	-1	-1	-1	-1	-1	1	1	1	-1	-1	99	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
51	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	3	1	97	97	2	2	-1	-1	-1	-1	-1	-1	-1	-1	1	1	-1	-1
52	-1	-1	-1	2	-1	3	1	-1	-1	-1	3	3	1	97	97	4	-1	-1	-1	-1	-1	-1	-1	-1	-1	2	-1	-1	-1
53	-1	-1	1	-1	-1	-1	-1	3	3	2	3	3	97	97	97	2	-1	-1	-1	-1	99	-1	-1	-1	-1	2	-1	-1	-1
54	-1	-1	1	-1	-1	-1	-1	2	3	-1	-1	-1	97	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
55	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	99	97	1	-1	-1	-1	-1	99	-1	-1	-1	-1	2	-1	-1	-1
56	-1	-1	-1	-1	-1	-1	-1	1	1	1	-1	-1	2	1	97	3	4	-1	-1	-1	2	-1	-1	-1	-1	4	1	-1	-1
57	-1	-1	-1	-1	-1	-1	-1	2	3	-1	-1	-1	97	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
58	-1	-1	1	-1	1	-1	-1	1	1	2	-1	-1	99	97	97	2	2	-1	-1	-1	-1	-1	-1	-1	-1	4	2	-1	-1
59	-1	-1	1	1	-1	-1	-1	-1	-1	2	-1	-1	1	97	97	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	4	-1	-1	-1
60	-1	-1	1	-1	-1	-1	-1	2	3	2	-1	-1	2	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
61	-1	-1	-1	-1	-1	-1	-1	1	3	2	-1	-1	1	97	97	3	3	-1	-1	-1	-1	-1	-1	-1	-1	1	1	-1	-1
62	-1	-1	1	-1	-1	-1	-1	2	3	-1	-1	-1	1	99	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
63	-1	-1	1	-1	-1	-1	-1	1	3	-1	-1	-1	97	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
64	-1	-1	-1	-1	-1	-1	-1	2	2	2	-1	-1	97	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
65	-1	-1	-1	-1	-1	-1	-1	2	3	1	-1	-1	97	97	97	2	-1	-1	-1	-1	2	-1	-1	-1	-1	4	-1	-1	-1
66	-1	-1	3	-1	1	-1	-1	1	1	2	2	3	3	1	97	3	2	-1	-1	-1	-1	-1	-1	-1	-1	1	1	-1	-1
67	-1	-1	2	-1	-1	-1	-1	2	3	-1	-1	-1	97	97	97	3	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1
68	-1	-1	-1	-1	1	-1	-1	1	3	-1	2	3	97	97	97	1	-1	-1	-1	-1	1	-1	-1	-1	-1	4	-1	-1	-1
69	-1	-1	1	-1	-1	-1	-1	2	3	-1	-1	-1	97	97	97	3	3	-1	-1	-1	-1	-1	-1	-1	-1	4	3	-1	-1
70	-1	-1	-1	-1	-1	-1	-1	2	3	-1	-1	-1	2	97	97	3	2	-1	-1	-1	-1	-1	-1	-1	-1	3	2	-1	-1
71	-1	-1	1	-1	1	-1	-1	1	1	1	2	3	97	97	97	2	3	-1	-1	-1	-1	-1	-1	-1	-1	1	1	-1	-1
72	-1	-1	3	-1	-1	-1	-1	2	3	1	3	3	2	97	97	2	3	3	1	-1	2	-1	-1	99	-1	4	2	2	2
73	-1	-1	1	-1	2	-1	-1	1	1	1	2	3	97	97	97	2	3	3	-1	-1	-1	-1	-1	-1	-1	4	4	4	-1
74	-1	-1	1	-1	-1	-1	-1	1	3	-1	-1	-1	97	97	97	2	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1
75	-1	-1	-1	-1	-1	-1	-1	2	2	2	-1	-1	5	97	97	2	4	-1	-1	-1	-1	-1	-1	-1	-1	4	2	-1	-1
76	-1	-1	1	-1	-1	-1	-1	1	3	2	2	3	97	97	97	2	-1	-1	-1	-1	99	-1	-1	-1	-1	2	-1	-1	-1
77	-1	-1	2	-1	-1	-1	-1	2	2	-1	-1	-1	1	5	97	2	2	2	-1	-1	99	99	99	-1	-1	1	1	1	-1
78	-1	-1	-1	1	-1	-1	-1	2	2	2	-1	-1	97	97	97	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

House I.D.	5	Liv. 1	Noise 2	3	4	5	F.F	Night
0	-1	-1	-1	-1	-1	-1	-1	-1
1	-1	1	1	1	-1	-1	-1	-1
2	-1	-1	-1	-1	-1	-1	1	1
3	-1	1	1	1	-1	-1	-1	-1
4	-1	-1	-1	-1	-1	-1	-1	-1
5	-1	1	1	1	-1	-1	1	1
6	-1	1	-1	-1	-1	-1	-1	-1
7	-1	1	1	1	-1	-1	-1	-1
8	-1	-1	-1	-1	-1	-1	2	2
9	-1	1	-1	-1	-1	-1	-1	-1
10	-1	-1	-1	-1	-1	-1	1	1
11	-1	-1	-1	-1	-1	-1	-1	-1
12	-1	1	-1	-1	-1	-1	1	1
13	-1	1	1	1	-1	-1	2	2
14	-1	3	-1	-1	-1	-1	-1	-1
15	-1	1	-1	-1	-1	-1	1	1
16	-1	1	-1	-1	-1	-1	1	1
17	-1	4	2	-1	-1	-1	1	1
18	-1	1	1	-1	-1	-1	1	1
19	-1	1	1	-1	-1	-1	1	1
20	-1	-1	-1	-1	-1	-1	1	1
21	-1	2	-1	-1	-1	-1	1	1
22	-1	3	1	-1	-1	-1	1	1
23	-1	1	1	-1	-1	-1	2	2
24	-1	-1	-1	-1	-1	-1	-1	-1
25	-1	1	1	-1	-1	-1	1	1
26	-1	1	1	-1	-1	-1	-1	-1
27	-1	1	-1	-1	-1	-1	1	1
28	-1	1	-1	-1	-1	-1	-1	-1
29	-1	-1	-1	-1	-1	-1	2	2
30	-1	1	-1	-1	-1	-1	1	2
31	-1	1	-1	-1	-1	-1	1	1
32	-1	1	-1	-1	-1	-1	98	98
33	-1	2	1	-1	-1	-1	1	1
34	-1	1	-1	-1	-1	-1	-1	1
35	-1	-1	-1	-1	-1	-1	-1	-1
36	-1	1	-1	-1	-1	-1	1	1
37	-1	1	-1	-1	-1	-1	1	1
38	-1	1	1	1	-1	-1	-1	-1
39	-1	2	1	-1	-1	-1	1	1
40	-1	1	1	1	-1	-1	1	1
41	-1	-1	-1	-1	-1	-1	-1	-1
42	-1	1	-1	-1	-1	-1	1	1

House I.D.	5	Liv. 1	Noise 2	3	4	5	F.F	Night
43	-1	2	1	1	1	-1	1	1
44	-1	3	3	-1	-1	-1	-1	-1
45	-1	1	1	-1	-1	-1	-1	-1
46	-1	1	2	1	-1	-1	1	1
47	2	1	1	1	1	1	1	2
48	4	1	1	1	1	1	1	1
49	-1	-1	-1	-1	-1	-1	-1	-1
50	-1	-1	-1	-1	-1	-1	-1	-1
51	-1	1	1	-1	-1	-1	-1	-1
52	-1	2	-1	-1	-1	-1	-1	-1
53	-1	2	-1	-1	-1	-1	1	1
54	-1	-1	-1	-1	-1	-1	-1	-1
55	-1	1	-1	-1	-1	-1	-1	-1
56	-1	4	1	-1	-1	-1	2	2
57	-1	-1	-1	-1	-1	-1	-1	-1
58	-1	1	1	-1	-1	-1	1	1
59	-1	1	-1	-1	-1	-1	-1	-1
60	-1	-1	-1	-1	-1	-1	-1	-1
61	-1	1	1	-1	-1	-1	1	1
62	-1	-1	-1	-1	-1	-1	-1	-1
63	-1	-1	-1	-1	-1	-1	-1	-1
64	-1	-1	-1	-1	-1	-1	-1	-1
65	-1	3	-1	-1	-1	-1	1	2
66	-1	1	1	-1	-1	-1	1	1
67	-1	1	-1	-1	-1	-1	1	1
68	-1	-1	-1	-1	-1	-1	1	1
69	-1	1	1	-1	-1	-1	1	1
70	-1	1	1	-1	-1	-1	2	2
71	-1	1	1	-1	-1	-1	1	1
72	-1	1	1	1	1	-1	1	1
73	-1	1	1	1	-1	-1	1	1
74	-1	1	-1	-1	-1	-1	1	1
75	-1	-1	3	-1	-1	-1	1	1
76	-1	1	-1	-1	-1	-1	1	1
77	-1	1	1	1	-1	-1	1	1
78	-1	-1	-1	-1	-1	-1	-1	-1

APPENDIX E

FAN LOCATIONS - HOMEOWNER SURVEY

Fan Locations - Homeowner Survey

House I.D.#	Fan #1	Fan #2	Fan #3	Fan #4	Fan #5
1	Kitchen	Bathroom	Bathroom		
2	N/A				
3	Kitchen	Bathroom	Bathroom		
4	N/A				
5	Kitchen	Bathroom	Livingroom		
6	Attic				
7	Bathroom	Bathroom	Kitchen		
8	N/A				
9	Bathroom				
10	N/A				
12	Bathroom				
13	Kitchen	Bathroom	Bathroom		
14	Kitchen	Bathroom			
15	Kitchen				
16	Kitchen				
17	Kitchen	Bathroom			
18	Kitchen	Bathroom			
19	Bathroom	Kitchen			
21	Kitchen				
22	Kitchen	Bathroom			
23	Kitchen	Kitchen			
25	Kitchen	Bathroom			
26	Kitchen	Bathroom			
27	Bathroom				
28	Kitchen				
30	N/A				
31	Bathroom				
32	Bathroom				
33	Kitchen	Bathroom			
34	Kitchen				
36	Kitchen				
37	Kitchen				
38	Kitchen	Kitchen	Bathroom		
39	Kitchen	Bathroom			
40	Kitchen	Bathroom	Kitchen		
42	Kitchen				
43	Bathroom	Kitchen	Bathroom	Bathroom	
44	Livingroom	Livingroom			
45	Kitchen	Bathroom			
46	Kitchen	Bathroom	Bathroom		
47	Kitchen	Stove	Bathroom	Bathroom	Bathroom
48	Bathroom	Bathroom	Bathroom	Kitchen	Basement
51	Kitchen	Bathroom			
52	HRV				
53	Kitchen				
55	Bathroom				
56	Bathroom	Bathroom			
58	Kitchen	Bathroom			

Fan Locations - Homeowner Survey - Page 2

House I.D.#	Fan #1	Fan #2	Fan #3	Fan #4	Fan #5
59	Kitchen				
61	Kitchen	Bathroom			
65	Kitchen				
66	Kitchen	Bathroom			
67	Bathroom				
68	Kitchen				
69	Kitchen	Bathroom			
70	Kitchen	Kitchen			
71	Bathroom	Kitchen			
72	Kitchen	Bathroom	Bathroom	Bathroom	
73	Kitchen	Bathroom	Bathroom		
74	Bathroom				
75	Kitchen	Bathroom			
76	Kitchen				
77	Kitchen	Bathroom	Bathroom		